NUMBER 77 JUNE 1944

THE BULLETIN

OF THE

U. S. Army Medical Department

A periodical containing original articles, reviews, news, and abstracts of interest to the Medical Department of the Army

ISSUED UNDER THE AUSPICES OF
THE OFFICE OF THE SURGEON GENERAL

PUBLISHED MONTHLY AT THE MEDICAL FIELD SERVICE SCHOOL,
CARLISLE BARRACKS, PENNSYLVANIA

By direction of the Secretary of War, the material contained herein is published as administrative information and is required for the proper transaction of the public business.

NORMAN T. KIRK
Major General, U. S. Army,
The Surgeon General.

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Foreword

With the October 1943 issue, The Bulletin became a monthly periodical, instead of a quarterly, dedicated to keeping the personnel of the Medical Department informed on developments in war medicine. The new publication, known as The Bulletin of the U. S. Army Medical Department, absorbed the former quarterly dental and veterinary bulletins and will have material devoted to those fields in each issue.

The Bulletin is intended to be educational rather than directive in nature. It will contain the best information obtainable concerning military medical experience, observations, and procedure that may help to improve further the quality of professional services. The Bulletin will be a medium whereby experience gained in one theater of combat may be shared with those serving in other combat areas and with those in this country who are preparing for overseas duty. News items concerning military and scientific developments as well as original articles will be emphasized. The Bulletin, however, should not serve as a basis for the forwarding of requisitions for equipment or supplies referred to therein.

Obviously, some of the most interesting field experiences cannot be divulged in a periodical of this kind when our country is at war. The Bulletin will, however, publish that which can be safely told, drawing not only on current literature, but on many authoritative reports which reach The Surgeon General's Office from the field. Officers are invited to submit for publication reports of their field experiences that can profitably be shared with other officers.

The Medical Department has been commended for its work in caring for the sick and wounded in theaters of operations in war. The Bulletin will endeavor to stimulate such progress and to advance further the high standard of medical service in the Army of the United States.

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Notice to Contributors

Contributions to The Bulletin should be typewritten, double spaced, with wide margins, and in duplicate including the original and one carbon copy. Great accuracy and completeness should be used in all references to literature, including the name of the author, title of article, name of periodical, with volume, page, and number—day of month if weekly—and year. Materials supplied for illustrations, if not original, should be accompanied by reference to the source and a statement as to whether or not reproduction has been authorized. Adequate legends should accompany each illustration in order to point out clearly to the reader the condition or lesion or other objectives, which in some instances should be indicated by a small arrow or other device. Each illustration and table should bear the author's name on the back; photographs should be clear and distinct; drawings should be made in black ink on white paper. Original articles will be accepted for publication on condition that they are contributed solely to The Bulletin and that editorial privilege is granted in preparing the material submitted for publication. Reprints may be ordered for official use. Arrangements for reprints for personal use may be made direct with the Book Shop, Medical Field Service School, Carlisle Barracks, Pennsylvania. The type will be held for two months following publication.

News and Comment

INDICATIONS AND CONTRAINDICATIONS FOR THE USE OF PENICILLIN

The following list was prepared by Dr. Chester Keefer of the Committee on Chemotherapeutic Agents of the National Research Council, and is concurred in by the Office of The Surgeon General.* Penicillin is the best therapeutic agent available at present for the treatment of:

1. All staphylococcic infections with and without bacteremia: acute osteomyelitis; carbuncles—soft tissue abscesses; meningitis; cavernous or lateral sinus thrombosis; pneumonia—empyema; carbuncle of kidney; wound infections.
2. All cases of clostridia infections: gas gangrene; malignant edema.
3. All hemolytic streptococcic infections with bacteremia and all serious local infections: cellulitis; mastoiditis with intracranial complications, i. e., meningitis, sinus thrombosis, etc.; pneumonia and empyema; puerperal sepsis; peritonitis.
4. All anaerobic streptococcic infections: puerperal sepsis.
5. All pneumococcic infections of meninges, pleura, endocardium; all cases of sulfonamide-resistant pneumococcic pneumonia.
6. All gonococcic infections complicated by arthritis, ophthalmia, endocarditis, peritonitis, epididymitis; also, all cases of sulfonamide-resistant gonorrhea.
7. All meningococcic infections not responding to the sulfonamides.

Penicillin is *contraindicated* in the following cases because it is ineffective:

All gram-negative bacillary infections:
- Typhoid-paratyphoid;
- Dysentery;
- *Esch. coli;*
- *H. influenzae;*
- *B. proteus;*
- *B. pyocyaneus;*
- *Br. melitensis* (undulant fever);
- Tularemia;
- *B. friedländeri.*

Tuberculosis.
Toxoplasmosis.
Histoplasmosis.

Acute rheumatic fever.
Lupus erythematosus diffuse.
Infectious mononucleosis.
Pemphigus.
Hodgkin's disease.
Acute and chronic leukemia.
Ulcerative colitis.
Coccidioidomycosis.
Malaria.
Poliomyelitis.
Blastomycosis.
Nonspecific iritis and uveitis.
Moniliasis.

*War Department Technical Bulletin TB MED 9, 12 February 1944.

To conserve space, some items in this issue of The Bulletin are set in type with less space between the lines.

TOURNIQUETS FOR EXTREMITY SURGERY

Tourniquet paralysis which has been noted in a number of instances, is an unfortunate complication and measures should be taken to avoid it. The practice of using a tourniquet varies with different surgeons, and the indications will not be discussed here. A tourniquet is commonly used in knee joint surgery to avoid sponging which traumatizes the delicate synovial tissue. It is recommended that suction with a small tip may be used to keep the operative field dry. The surgeon himself is responsible for the proper application of a tourniquet and for complications which may result. The two general types of tourniquets are rubber tubing or bandage and pneumatic tourniquets. In the application of the former, the pressure cannot be measured and depends on the judgment and experience of the individual who applies it. Practically all the complications observed have been from the use of a rubber tube or rubber bandage type which undoubtedly has been applied with too much force. A pneumatic tourniquet may be of a commercial type or a standard blood pressure cuff, both of which require a reinforcing envelope or bandage to protect the rubber bag. The pneumatic tourniquet records pressure in pounds per square inch or in millimeters of mercury, and it should be noted that one pound is equivalent to 51.7 millimeters of mercury. For the arm, 5 lb.-pressure, or 250 millimeters of mercury, is usually sufficient, and for the leg the pressure should not exceed 10 lb. In fact, if the thigh is not too large a carefully applied blood pressure cuff in which the pressure does not exceed the 300-millimeter mark may suffice. Except under emergency circumstances, only a pneumatic type of tourniquet should be used in elective extremity surgery. Many named general hospitals are equipped with a suitable nonstandard commercial pneumatic tourniquet. An improved type is in the process of development with a view to its adoption as a standard item for appropriate hospitals.

ELECTRIC FANS

Electric fans are available to hospitals, both in the zone of the interior and theaters of operations. Their use is authorized only for hospital purposes where the comfort of patients is involved. They are not to be used in offices, kitchens, or other areas not frequented by patients, nor will they be issued to those hospitals in which air-conditioning systems are already installed. These items are being added to Medical Department Equipment Lists for zone of interior hospitals, but theater of operations installations requiring fans (Items No. 77970 and 77980) should forward requisitions through the proper channels to the supply depots regularly servicing them, with a full explanation justifying the quantity requested.

NOTIFICATION OF CASES OF TUBERCULOSIS

Recent reports from state public health departments indicate that Army medical installations have not always complied with regulations that demand proper notification of cases of pulmonary tuberculosis. Medical officers are reminded of the provisions of AR 40-1080, section VI, paragraph 44, entitled "Notification of communicable disease in persons separated from Army service." This paragraph requires a report to the civil health authority in the state in which the individual contemplates making his home in the case of all persons separated from active Army service or rejected for enrollment because of communicable disease. Active tuberculosis is reportable as a communicable disease in all states and is therefore to be included under the provisions of the regulation named. The regulation applies to those rejected at induction stations, as well as those separated following hospitalization.

TICK-BORNE TULAREMIA

Fifteen cases of tick-borne tularemia in soldiers admitted to an evacuation hospital in Tennessee have been reported by Major George V. Byfield and Captains Lawrence Breslow, Roland R. Cross, Jr., and Noel J. Hershey, Medical Corps, as occurring during a period of thirty days last spring. These soldier patients had slept on the ground in pup tents and been out of doors almost continuously, frequently in wooded terrain. Ten patients had definite histories of tick bite and most of them had found ticks in their clothing or on their bodies. All of the patients recovered but, in some, the disease was moderately severe and caused prolonged debilitation. The earliest tularemic lesions noted were areas of skin 2 to 3 cm. in diameter, showing central necrosis and ulceration; 13 patients had large masses of red, tender, and moderately firm regional lymph nodes which later in some cases became soft and fluctuant, due to abscess formation. One patient developed pneumonia with pleural effusion; another had nuchal rigidity and a positive Kernig's sign but the cerebrospinal fluid on examination appeared normal. The leukocyte count varied from normal to 16,650 per cu. mm. The positive blood agglutinations ranged from 1:320 to 1:1280. No attempt was made to treat the patients other than symptomatically, the surgical drainage of abscesses in 3 cases, the use of metaphen in one case, and the chance use of sulfonamides in 6 cases prior to admission and in 2 cases after admission. In the 45 days following the period covered by this report, 11 additional cases of tularemia occurred. As each case requires a minimum of from 6 to 8 weeks of hospitalization and convalescence, this disease has some military importance.

Of 600 cases of tularemia reviewed by Foshay in *Medicine* in 1940, 6 were attributed to tick bites. Francis in the following year reported 53 cases of tularemia in Montana and surrounding states caused by *D. andersoni* and 73 cases, principally in the southern states, caused by *D. variabilis*. Dr. Norman H. Topping, U. S. Public Health Service, recently made a tick survey in an area in which a number of the patients reported by Major Byfield and associates had bivouacked and he reported, the authors say, that all specimens were *Amblyomma americanum;* however, the ticks collected in this survey were tested by E. Francis and R. R. Parker and neither was able to demonstrate *Past. tularensis* by culture. As *D. variabilis* is known to be present in this general area, it would seem justifiable to suspect that either or both types of ticks were the transmitting agents among the soldiers affected.

COCCIDIOIDOMYCOSIS

This disease is a fungus infection occurring in portions of the arid southwestern part of the United States. It is transmitted by the inhalation of the spores of the causative fungi which are present in dust in the endemic regions. Its distribution is very spotty, and except for the San Joaquin Valley of California most of the endemic areas appear to be quite small in extent, and the location of these areas is not well established. The seasonal distribution of the coccidioidomycosis is determined by the amount of rainfall, the incidence being much higher in the dry seasons. Most of the 1,200 cases reported in 1943 occurred during the fall and winter.

The endemic regions are generally the most nearly ideal regions for flying, chiefly because of their almost continuously clear weather. They also serve admirably for desert training of ground force troops. Military necessity has therefore dictated the extensive use of these regions by a large number of air force units and a lesser number of ground force organizations, only areas known to be heavily infected being avoided. Certain of these areas have been discovered only through the appearance of the disease among troops or by observing positive reactions to the coccidioidin test in troops previously bivouacked or stationed there. Recently a number of cases have been diagnosed in nonendemic areas, particularly on the east coast. These have occurred among soldiers transferred from an endemic area during the incubation period of the disease.

Benign acute coccidioidomycosis is a disease which resembles mild influenza in its symptoms and in which the lesions are limited to the lungs. The majority of cases recover completely in a few weeks. Occasionally, however, dissemination or the development of progressive secondary lesions

follows. The disease is rarely fatal. Its military importance results from the rather long period of hospitalization required.

The Commission on Epidemiological Survey of the Army Epidemiological Board has extensively investigated coccidioidomycosis with the aid of medical officers attached to units in the endemic region. In 1942 the Army Air Forces Western Flying Training Command developed a comprehensive control program. The Surgeon General has taken steps to keep forces assigned to the general endemic area informed of the location of foci of infection as they are identified. Diagnosis aids and consultant services are provided.

MEDICAL SUPPORT IN MOUNTAIN WARFARE

A long half-mile lay between an American aid man stationed at an outpost in the mountains of India and a medical officer at the aid station down the precipitous slope. A soldier of the battery at the outpost was critically ill and despite emergency treatment his condition became worse. Immediate skilled treatment, such as only a medical officer could give, was indicated. Under ordinary conditions, litter bearers from the aid station would have evacuated the man in short order, but in the mountains of India the time normally required for evacuation frequently lengthened into days. The unbeaten route down the mountain was tortuous and the patient could not endure the trip. The officer could not climb the mountainside in time to save the man's life.

As the aid man understood the impossibilities which the terrain presented, he contacted the medical officer by means of wireless and gave a detailed account of the soldier's symptoms. In a series of messages, the aid man communicated a clear clinical picture down the mountain to the officer, who diagnosed the case as acute appendicitis and determined on immediate operation. The two agreed on a site midway on the slope to which the aid man would transport the patient and to which the officer would climb from below. They met as arranged, the operation was performed, the man's life was saved.

Similar experiences on other front lines, particularly in Italy, have made medical support in mountain warfare a paramount problem in this war. There are an amazing number of complicating factors. It takes longer to find and reach the wounded in the vast mountain regions. Once located, slow and cautious evacuation may take litter bearers over cliffs,

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This item is not to be interpreted as altering or supplementing existing doctrine which cannot be revised on the basis of isolated individual experiences. For doctrine on this subject see par. 127, FM 8-10, 28 March 1942; section VI, FM 21-11, 7 April 1943; TF 1297, "First Aid in Snow and Extreme Cold."

narrow, poorly marked trails, down boulder-strewn slopes, grass slopes, snow-covered slopes, over heaps of debris, and through thickly wooded patches. High altitudes and cold bring increased oxygen demands for litter bearers and force them to work slowly to conserve their energy. Under the most favorable of mountain conditions the rate of evacuation by hand-carry is not more than 500 yards an hour and frequently it is much slower. At least six bearers generally are required.

An American division surgeon in Italy reports: "Litter bearers must be young and in fine physical condition, as it may require two or three squads for each litter case to be evacuated. Train litter bearers to carry loaded litters over long, difficult routes, with all types of carrying. It took twenty men from one company to bring two wounded men six miles. On account of narrow trails, we may have to work out some kind of litter which permits its attachment, by a kind of buckle on litter ends, to shoulders of the carriers." Members of the Command and General Staff School substantiated the surgeon's remarks during a tour in Italy. "Casualties were nearly always evacuated initially by hand-carried litters and a six-man squad was found desirable. Casualties were removed to a jeep-ambulance head (advanced ambulance loading point). Jeep ambulances are hard-riding for patients but those with removable frames are used for supply and evacuation as there has been some shortage of ambulances, and the ambo-jeep can go places the heavier vehicle cannot negotiate. In one division all jeeps had a vertical metal shaft built on the forward part of the vehicle, with a light, angle-cutting edge to break wires stretched across the road by the enemy, thus saving many heads from serious injury during night driving. Floors of vehicles were covered with sand bags to lessen damage to riders from mine explosions." The members reported also that some attempt has been made to use Italian pack animals for evacuation, but "not very successfully."

Slow evacuation is even more serious in the mountains than on the level because of the low temperatures and danger from frostbite and exposure. The effects of shock may be severe in the cold even in cases of minor injuries. The tourniquet is not recommended because of the danger of freezing. Moreover, the sick or injured are likely to become apprehensive on the long, twisting evacuation trip, particularly if necessary to lower them over cliffs. The fact that it usually is necessary to strap the patient to the litter while going down mountains adds to his uneasiness and aggravates his condition.

An additional difficulty is that many wounded men who could walk must be evacuated in the mountains by litter. There may be deep snow and the medical installations may be far to the rear.

The British also are concerned about the problem and have suggested a plan for attaching to mountain companies small medical units whose entire equipment would be carried

by the personnel themselves. Such units would be in charge of noncommissioned officers trained especially in resuscitation and in the care of frostbite, gunshot wounds, and exposure. They would be equipped with special light litters, ski litters, and one-man sledges.

The United States Army has been conducting special training in mountain warfare for a medical battalion at Camp Hale, Colorado. Special physical standards are required of the personnel, even to guarding against chronic "altitude sickness." Each medical battalion is assigned seventy-two mules and fifty-three hand carts for transportation of equipment. Pack saddles are supplied with each mule, all are furnished by the quartermaster pack companies.

While the training of this medical battalion follows MTP 8-1, there are additional features. Each man is instructed in mountain terrain and weather, and litter bearers are trained in the selection of routes and in the use of the excellent defilade afforded by mountain areas. A necessary requirement is the ability to become adjusted to high altitudes. The men are taught to construct lean-tos and snowhouses and to supply warmth for themselves and patients. Sanitation and the ability to ski and travel on snowshoes are emphasized. Animal packing and rock climbing are special courses. Training in emergency medical treatment is particularly thorough because of the need for emphasis on methods for such treatment in snow and cold.

The 10,000 foot altitude of Camp Hale lends itself to the practical application of various means of evacuation, including the use of fixed ropes, cacolets, travois, motor vehicles, tramways, cable cars, toboggans, sleds, and snow vehicles. Nothing has been found, however, to replace completely the litter with hand-carry, although many experiments have been made. The emphasis remains on litter-bearer teams which are now used in relays with warming points at each relay post.

REPAIR OF HOLES IN SCREENS

The usual method of repairing holes in screens by sewing on a patch with copper wire is time-consuming. Lieut. Colonel F. H. Stover, Sn.C., has suggested a simpler and more rapid method. With scissors or other sharp instrument, cut a square patch of new wire screening about twice the size of the hole to be repaired. Unravel and pull completely out of the mesh three or four strands of wire from each side of the patch; then turn the fringe (the free ends of the patch) up perpendicular to the sides of the patch, which will then bear some resemblance to a shallow tray. Now turn the patch over and place it on the hole in the screen and with a hammer or any object, except your hand, pound the patch down over the hole. The free loose ends thus become enmeshed in the screen under repair and securely fasten the patch over the hole.

VAMPIRE BAT RABIES IN TRINIDAD

Paralytic rabies, transmitted by the vampire bat, has been essentially dormant in Trinidad since 1938; recently, however, it has reappeared among cattle. The ability of the vampire bat to transmit rabies was demonstrated in 1916, following a decade of experience and study of a paralytic disease of livestock in Brazil. Severe epizootics of this form of rabies have occurred in cattle in Brazil and in Trinidad, and it has been reported from Paraguay, Venezuela, Argentina, and British Guiana. A severe epizootic in cattle in Trinidad in 1929 was followed during the next six years by a number of human cases acquired by infection from bats. Vampire bats have the ability of harboring the rabies virus in the salivary glands for long periods of time without acquiring the disease themselves. The vampire bat inhabits a large part of Central and South America.*

LIBRARY LOAN SERVICES

The Army Medical Library, Washington, D. C., which contains the largest collection of medical literature in the world, will send literature on request to medical officers within the United States, so far as the exigencies of the times permit, in view of a much greater demand for such material and the much greater amount of work which the library now has to do. The request may include as many as ten items and the material may be used as long as two weeks before its return. Rare books, loose-leaf material, and reference texts are not available for circulation, but photographic copies or microfilms may be furnished.

Requests for loan material should be sent to the library in duplicate giving complete data, including the author's surname, title of book or article, and, if a book, the edition, place and date of publication, and publisher; or, if a paper, the journal, year, volume, and page.

The Medical Library Association has placed at the disposal of medical officers of the armed forces the facilities of 250 member libraries throughout the United States. These libraries may be visited by medical officers who are stationed nearby, or the loan of books and journals can be arranged on request. Details of this service appeared in Army Medical Bulletin No. 64, October 1942, and in S.G.O. Circular Letter No. 27, "Staff rounds and meetings in hospitals of the Medical Department of the United States Army," 22 January 1943.

Certain civilian medical organizations, such as the American Medical Association, 535 North Dearborn Street, Chicago, the American College of Surgeons, 54 East Erie Street, Chicago, and others, have files of reprint material which will be lent to medical officers on request.

*A paper on this subject, by Colonel (now Brigadier General) L. A. Fox, M.C., was published in Army Medical Bulletin No. 60, January 1942, pages 122 to 127.

PATIENTS EVACUATED BY AIRCRAFT

More than 173,000 sick and wounded patients of United States and Allied forces were evacuated by American military aircraft throughout the world in 1943, the War Department has announced. This figure refers to sick and wounded patients admitted to a medical service and therefore includes not only nonbattle casualties, but also individuals who have been air-evacuated more than once from one hospital to another. This figure cannot, therefore, be compared with totals appearing in battle casualty lists.

A total of 3,260 individuals was evacuated from theaters of operation into the United States aboard Air Transport Command airplanes. The totals of patients evacuated in the major theaters of operation are as follows: New Guinea, 70,808; Solomon Islands, 24,767, and Tunisia, Sicily, and Italy, 58,479. In the Mediterranean area, where evacuated patients were flown a total of 16,491,266 miles and 131,762 hours, the average flight was 282 miles and the average flying time 2.2 hours. The customary evacuation route from Guadalcanal in the Solomon Islands was more than 1,000 miles and the flying time ranged from 4½ to 7½ hours. Evacuation in New Guinea involved shorter hops in the majority of cases, the exception being the 700-mile flight to Australia. Medical Air Evacuation Transport Squadrons, consisting of flight surgeons, flight nurses, and enlisted men trained at the A.A.F. School of Air Evacuation, Bowman Field, Kentucky, are now on duty in all parts of the world. Twenty-five M.A.E.T. squadrons have been activated since December 1942.

A study of the types of patients evacuated, reactions noted, and causes of death in flight has been projected by the School of Air Evacuation. The number of deaths during flight in 1943 was 11, a rate of .006 percent, or 6 per 100,000 patient-trips. Major General David N. W. Grant, the air surgeon, said: "On the basis of the A.A.F.'s first full year of experience in the air evacuation of war casualties, we can conclude that this is the method of choice for the quick, safe, and comfortable transportation of virtually all types of sick and wounded patients. Air evacuation in troop and cargo carriers has solved the logistical problem of casualty evacuation without any addition of vehicular equipment to Medical Corps units, and has contributed considerably to the tactical success of every major land offensive involving American forces. It has reduced the need for hospitalization in forward areas. Its swift and comfortable delivery of the patient to a hospital equipped for definitive medical care places air evacuation in a group with the sulfa drugs and blood plasma as one of three greatest life-saving measures of modern military medicine."

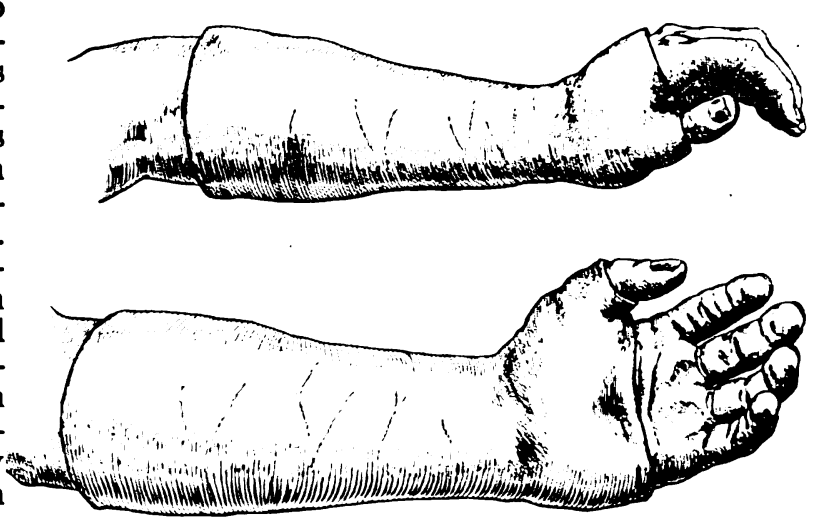
ADAPTABILITY IN TIME OF WAR

After a period of training at a camp in Oklahoma, a certain unit moved to a camp where the organization was welded into a functional group and then moved to a port of embarkation, then on to a foreign theater where it cared for many casualties in tents under extremely difficult climatic and sanitary conditions. A significant and typically American trait is revealed in the final paragraph of the historical report:

> In looking back upon the past year's activities, we note that the realization has been totally different from the expectation. That for which we planned was predicated, for the most part, on fixed installations in buildings with steam heat and glass windows. One year later, we find ourselves in a tent village on an African hillside, striving for survival. It has been observed that every move took us a little nearer nature and closer to the ground. One of the amazing things in this metamorphosis has been the adaptability to environmental conditions, whether that of a straddle trench, a sand storm, or a subtorrential rain. The year's experience has proved that the highest efficiency of a hospital unit can be maintained anywhere, regardless of environmental conditions.

FRACTURED CARPAL NAVICULAR BONE

Fractures of the carpal navicular bone present an important diagnostic problem. Cases which receive early and adequate treatment usually develop bony union, whereas failure to diagnose or to properly immobilize this type of fracture results in nonunion and prolonged disability. Plaster immobilization is indicated until evidence of firm union is established by x-ray. In spite of anteroposterior and lateral x-rays, a fracture may be missed; therefore careful technique including oblique views is necessary. Often the fracture is not discovered on the first examination but is apparent on subsequent films. To reduce the incidence of nonunion, it is recommended that all severe "sprains" of the wrist simulating fractures of the navicular be treated by plaster immobilization for two weeks followed by a second x-ray examination which should rule out a fracture. Figure illustrates the method of plaster immobilization.



PAIL LATRINE SYSTEM

At a camp built on low land in Florida, the use of pit latrines was found unsatisfactory because the water level was only 24 inches below the surface of the ground. The pail latrine system was then installed. The following account is from a report by Captain Olney Borden, Sn.C., made when the number of latrines in use was 217, including 15 in the training areas, some of which were several miles from the troop areas. The majority of the latrines had eight or ten seats and pails, while the total number of pails in use was 1,970.

Service

The pails are serviced daily except Sunday by the medical sanitary company comprised of 14 crews, each having a private first class and three privates. The 1½-ton trucks have a 4-wheel drive with metal box bodies, each carrying between 80 and 100 clean pails at the start of the day. The pails are taken from the latrine, the covers are put on, and they are placed on the truck. One man scrubs the floor on which the pails were placed, using a broom and water to which cresol is added. Clean pails are then properly placed under the latrine seats and the doors closed tightly. When the truck is full of used cans, they are taken away to the disposal area.

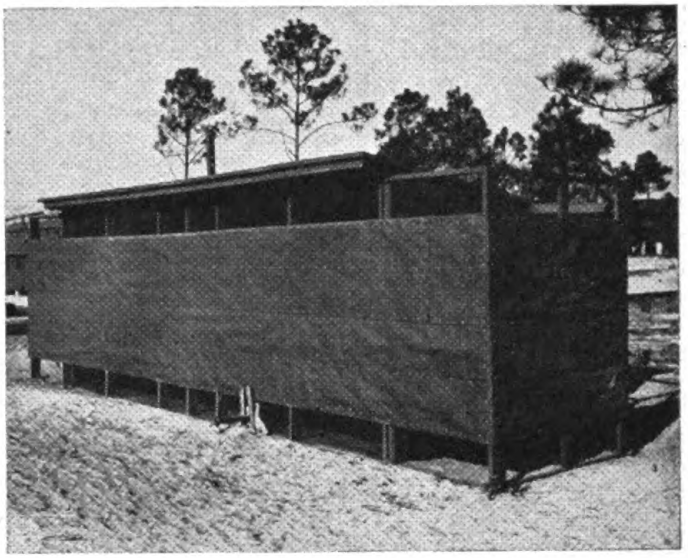


FIGURE 1. Pail-type latrine. Note 1½-inch iron pipe outlet of urine trough. This leads into 50 feet of farm tile laid in gravel for urine disposal.

Disposal

The four disposal areas are located at convenient points near the troop camp where the ground water is at least 6 feet below the surface. Holes 6 by 6 by 6 feet are dug and the human refuse from the pails dumped into them. Each hole can be used from three to four days. At the end of each day, the hole is thoroughly sprayed with No. 2 Diesel oil and 6 inches of loose dirt is thrown in to cover it for the night. The spraying includes the sides of the hole and an area 2 feet wide around the top. When the holes become filled to within 18 inches of the top, the surface is well sprayed and the balance of the hole filled with loose dirt. As the refuse dries, the hole is filled up each day

until the ground becomes firm and then two mounds or "graves" are built over each hole and marked with wooden markers with the date it was filled on the marker. The "graves" are sprayed with No. 2 Diesel oil every week for several months. The disposal areas have been in use now more than six months and there has been no fly or other insect breeding at any of them.

FIGURE 2. Back of latrine showing removal of used pails.

Care of Pails

After the pails are dumped, 5 gallons of hot soapy water are poured in to rinse them. This water is dumped from one pail to another until it cools and then is thrown in the hole and more hot water used. The pails are then loaded on the truck and taken to the steam sterilizing unit.

Water for the sterilizing unit is obtained by driving two well points about 20 feet into the ground. A small electric pump draws this water and maintains a pressure of between 20 and 40 pounds. A small pitcher pump is fastened to a well point to supply water for the hand-washing system. Care should be taken in locating the water supply so it will not drain water from the dumping pits.

FIGURE 3. Dumping pails in pit.

The pails are placed over the spray nozzles and sprayed with water under about 30 pounds' pressure to loosen and wash out the fecal matter; then they are sterilized with the steam nozzles both

inside and outside. This steam is under about 100 pounds' pressure. The pails are now rinsed over the spray nozzles and a light coat of cresol applied to the inside of the pail with a brush. The clean pails are then loaded on the truck to be returned for another load. The average time required for a truck to make a complete round trip and be back ready to service another group of latrines is ninety minutes Each truck makes at least two trips daily and the average number of pails each truck services is 190.

Nine soldiers work in each disposal area, 7 privates, 1 corporal, and 1 sergeant. They clear the brush off an area to prepare for new "graves," dig the holes, spray the holes, line up the "graves" and spray them weekly, run the sterilizing equipment, and handle pails while being cleaned. The four men on the truck dump the pails and load them on the truck. The truck crews can make two or three trips before noon; usually two hours' work is required each afternoon, making six hours in all to complete the work. The pails are not serviced on Sundays. This practice has not created any nuisance as about 25 percent of the command is away over the week end, and it is seldom that any pails get more than 75 percent full.

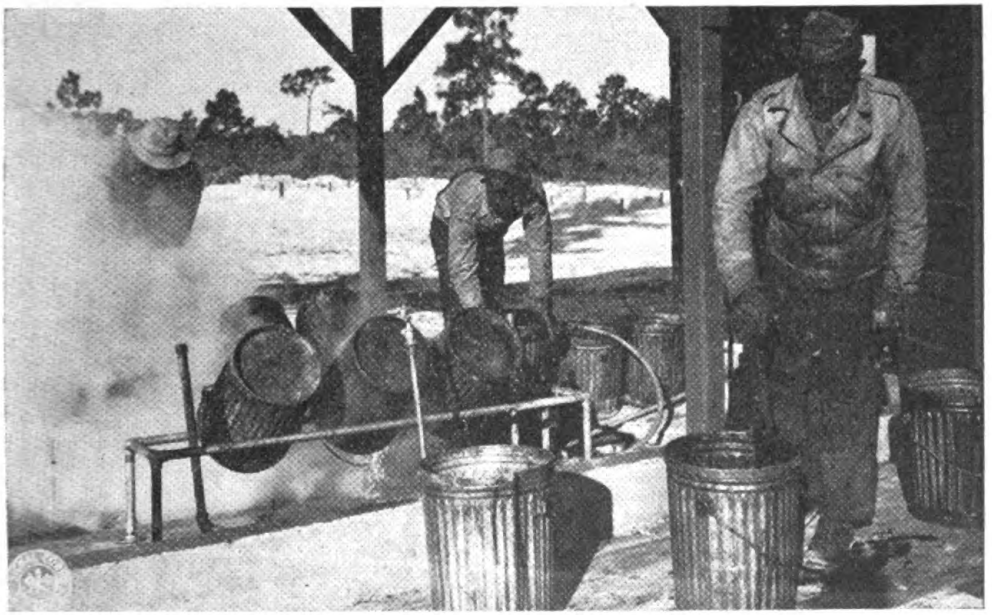


FIGURE 4. Cleaning pails with steam sterilizer. Man in foreground is applying cresol to cleaned buckets.

Hand-Washing Method

Before the sterilizing units were put in use, the pails were washed by hand. They were dumped and rinsed the same as now but the actual washing was done with G. I. brushes with long handles and hot soapy water. This method was satisfactory but the steam sterilizer does the job better with less handling with hands, and there is little difference in the amount of time required in the two methods.

FIGURE 5. Disposal area showing mounds.

FRACTURES OF THE ANKLE

The term "uncomplicated Pott's fractures" as referred to in Circular No. 12, War Department, 10 January 1944, is being interpreted too loosely in some instances. Almost all bimalleolar fractures can be reduced by conservative measures, but if the reduction is not satisfactory or cannot be maintained, early operation is indicated. Trimalleolar fractures require operation more frequently in order to reduce and fix the posterior portion of the articular surface of the tibia especially if the fragment is large. Diastasis of the distal tibiofibular joint with resultant widening of the ankle mortise is frequently associated with fractures at the ankle. Since this diastasis is commonly unrecognized, and the resultant disability becomes permanent, its occurrence should always be borne in mind and ruled out by x-ray and clinical examinations. Complete reduction must be maintained with or without operative fixation. When operative treatment is necessary it is best accomplished by compression with a stand-

ard tibia bolt (Med. Dept. Item No. 30115). Skeletal traction with a Kirschner wire is particularly valuable in the os calcis in severe ankle fractures when used in combination with plaster immobilization or open operation. Fractures of weight-bearing joints require as nearly anatomical reduction as possible and if operation is necessary to attain this objective the case should be transferred to the appropriate hospital soon after injury.

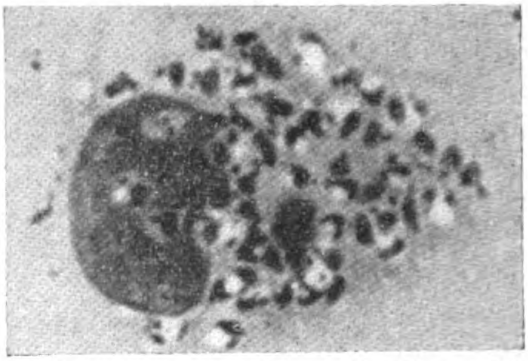
THE NEW GRAPHIC PORTFOLIO ON FIRST AID

The new Medical Department graphic portfolio on first aid is a teaching aid which by dramatic combat pictures presents the basic principles of first-aid treatment. The discussion of general principles is climaxed by a series of paintings in color, prepared by some of the leading artists. These paintings depict problem situations that illustrate the important types of combat wounds—abdominal wounds, face and chest wounds, fractures, broken back, and other emergencies. The accompanying narrative on each sheet directs the instructor in the doctrine to be covered and furnishes questions for inducing active audience participation. The portfolio comprising fifty pages, each 28 by 40 inches, is suitable for instruction of groups of platoon size. It is distributed by The Adjutant General on the basis of one portfolio per company or similar sized unit.

CUTANEOUS LEISHMANIASIS

Cutaneous leishmaniasis (oriental sore) has been reported from the Persian Gulf Command. Cases occurred in the latter part of the season of high sandfly incidence and immediately following it. A provisional diagnosis based on the clinical appearance of the lesions was confirmed by the demonstration of *Leishmania tropica* in stained material obtained by scraping the ulcers. The lesions varied from small papules to ulcers four centimeters in diameter. Although single lesions were seen, it was not uncommon to find ten or more typical sores in one person, distributed on the extremities, thorax, and face. The treatment reported was principally local treatment. Infiltration of the margin of the lesions with 1 percent berberine sulfate at semiweekly intervals caused adequate response in most of the cases. A special diagnostic and therapeutic clinic was established by a general hospital, and a clinic for ambulatory treatment was established by a field hospital.

Cutaneous leishmaniasis of right arm of a Chinese. Duration four years. Photograph by Museum and Medical Arts Service.



Large mononuclear cell filled with leishmaniform stage of *L. tropica* from lesion of cutaneous leishmaniasis (oriental sore). 1800X. Preparation by J. H. Wright, Army Medical Museum. Negative No. 4131.

ARMY MEDICAL MUSEUM SEMINARS

Colonel Esmond R. Long, Office of The Surgeon General, discussed "The Army's Experience with Tuberculosis," at the Army Medical Museum on 11 March. At the seminar on 18 March, Dr. A. W. Pappenheimer, professor of pathology, Columbia University College of Physicians and Surgeons, New York, current resident in pathology at the Museum, discussed "Cases of Anemia with Intracorpuscular Inclusions of Unknown Nature." Dr. N. Dugal, dean and professor of pathology of the University of Iceland, discussed "Indigenous Characteristics of the Incidence of Disease in Iceland," 1 April 1944, and Colonel Raymond Randall, V.C., director, Army Veterinary School, "Rabies and Its Relation to Public Health," on 8 April.

A DEMON OF THE WARM SEAS

The stingrays are flat, disk-shaped fish with a long tail and a sharp spine with which they may inflict dangerous and sometimes fatal wounds. Many different species of stingrays (a word often corrupted to stingaree) are present in all warm seas and in some tropical rivers. Some fresh-water stingrays have been found in South America more than 1,000 miles above the mouth of a river.

The Curator of Fishes, U. S. National Museum, Leonard P. Schultz, has referred to several cases in which persons were injured by the stingray: the case of a colonist in Guiana, cited by Dr. H. M. Evans of the Lowestoft Hospital, England, which was fatal; two other persons who recovered after a long period of suffering; Mr. Schultz's assistant, who was with him collecting fishes for the National Museum in Venezuela, was painfully injured by a stingray; the case of an assistant to Harvey Bassler, who was struck on the foot by a stingray far up the Amazon River and suffered extreme pain. Dr. Evans relates that a person along the China coast was wounded in the thigh resulting in paralysis of the limb.

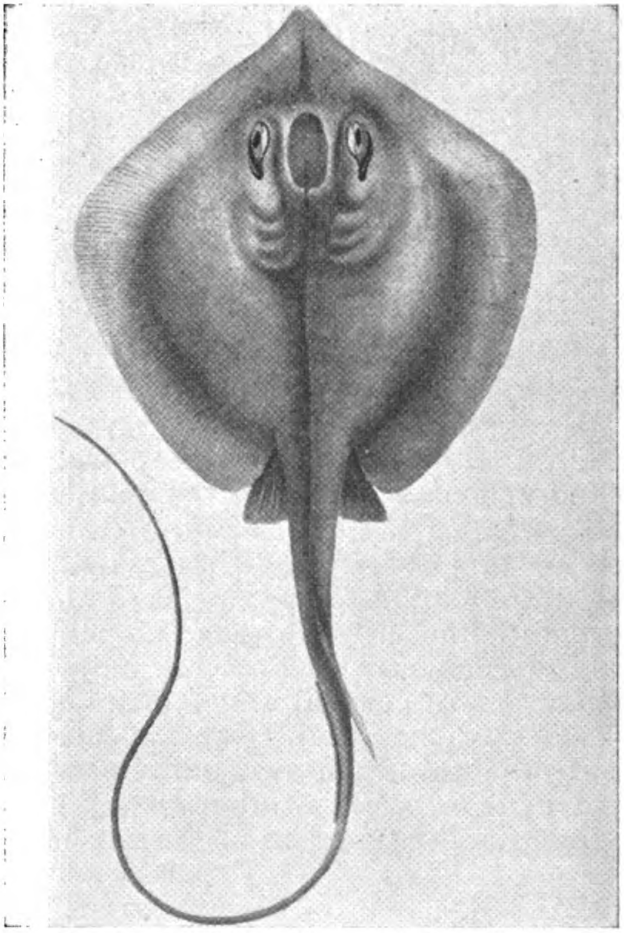


FIGURE 1. The stingray, *Trygon*, of the southwestern Pacific Ocean.

The fresh-water stingray is small compared with the giant stingray of Australia, which may be 14 feet long, weigh hundreds of pounds, and have a sting a foot long. The stingrays are a potential danger to anyone who wades in tropical waters.

They rest on the bottom and when disturbed swim with an undulating motion, setting up a cloud of mud or sand which makes them difficult to see. Stepping on the body of the stingray anchors it and provides the leverage it needs to drive its spine perhaps through one's foot or even into the bones.

The poison gland of the stingray is in a groove on the ventral surface of the spine. The barbs along the sides of the spine tear a jagged wound; should the sting break off, it has to be pushed on through or be removed by dissection.

The danger of stepping on a stingray can be almost eliminated by pushing one's feet along the bottom or the upper layer of mud or sand. The ray wriggles off the moment something touches it. One should carry a pole and probe the bottom as he walks forward. The stingray may be found in water only a few inches deep.

POTENTIAL HAZARD IN SERVICE CAP INSIGNIA

Captain Ernest D. Epstein, M. C., squadron surgeon in a theater of operations, has observed three cases recently of puncture wounds affecting the frontal bone and overlying skull coverings caused by excessive protrusion of the screw which holds on the service cap insignia. These injuries followed accidents in which the soldier's head was thrown violently against the windshield of a motor vehicle. An inspection of the entire squadron revealed this potential hazard in a large number of service caps, the metal screw protruding beyond the nut in some caps as much as one inch. When blows are sustained over the area just anterior to the bregma or point of junction of coronal and sagittal sutures, the screw may be forced into the skull. Captain Epstein points out that the excess length of the protruding screw can be readily cut off with a file or pliers or otherwise at a point immediately distal to the attaching portion of the cap insignia.

CARE OF SURGICAL INSTRUMENTS AND APPARATUS

The War Department has published a small technical manual (TM 8-611) to provide information and guidance in the care and maintenance of surgical instruments, blood transfusion apparatus, syringes, needles, and rubber goods. In the April Bulletin, page 32, the item entitled "The Care of Cystoscopes," was from an advance copy of this manual.

CARE OF DENTAL ANGLE HANDPIECES

As handpieces become unserviceable through lack of proper care, the following information from Captain W. L. Hammersley, D.C., may interest some dental officers. Most dental clinics have an air compressor and this device will apply to any air-pressure tank that has an extra outlet. A cutoff valve at the tank is desirable to avoid too much pressure in the rubber hose at the work bench.

A pipe line from the pressure tank or air line in the clinic leads to the work bench where handpieces are cleaned. At the end of the pipe line is a hose with an air cutoff valve to which a spray bottle (Med. Dept. Item No. 36122) can be attached. The nozzle on the spray bottle must insert directly into oil holes of handpiece. The spray bottle can be filled with kerosene, carbon tetrachloride, or lubricating oil which under the air pressure will wash dirt and old grease from handpieces. Carbon tetrachloride is preferred as it does not leave a gummy film over the metal, as kerosene does. After the handpiece is washed out thoroughly in this manner, it is greased with lubricating grease (Med. Dept. Item No. 52627). To avoid waste, the kerosene or oil should be caught in a pan while cleaning the handpieces, as after straining through several layers of dental napkins, it can be used many times. This method is not a cure-all for worn-out handpieces. It is offered for its simplicity and effectiveness in lengthening the life of handpieces.

OPHTHALMOLOGY BRANCH ESTABLISHED

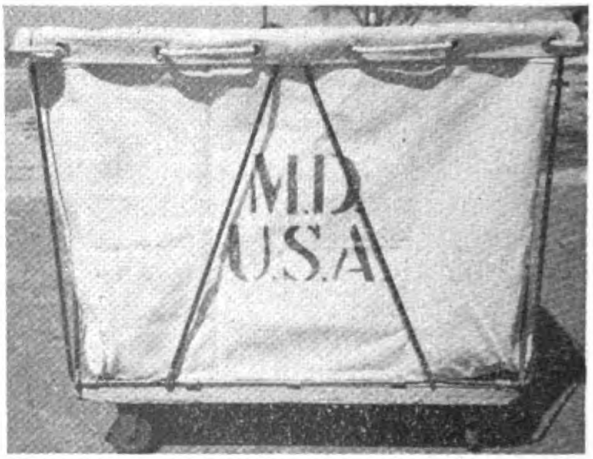
An Ophthalmology Branch has recently been established in the Surgery Division of The Surgeon General's Office with Major M. E. Randolph, Medical Corps, as Chief. This branch will concern itself with all matters pertaining to ophthalmology in the Army.

CENTER FOR TREATMENT OF ARTHRITIS

A center for the diagnosis and treatment of arthritis has been set up at the Army and Navy General Hospital, Hot Springs National Park, Arkansas, the War Department announced on 2 March. All severe and prolonged arthritic cases to be treated by the Army will be sent to the hospital, which is already specially equipped for treatment of diseases of the joints and has facilities for extensive physical therapy. It is hoped to make this hospital a source of extensive knowledge on arthritis for the whole medical profession. Studies will be carried on in the use of special drugs, such as the sulfonamides and penicillin, in the treatment of arthritis. Lieut. Colonel Phillip Hench, M. C., A. U. S.., formerly of the Mayo Clinic, Rochester, Minnesota, has been placed in charge of medical service at the hospital.

UTILITY CARRIER FOR CANTONMENT HOSPITAL

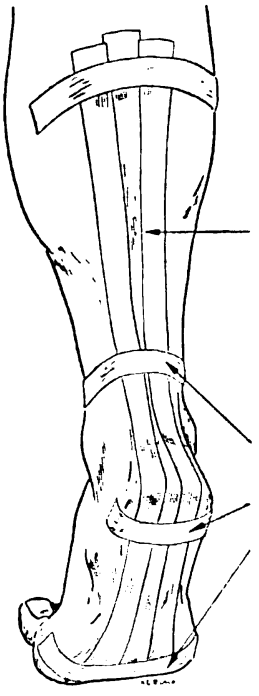
In large cantonment-type station hospitals the distances from some units to the supply warehouse are as much as one mile. The major problems of transportation of linen, mail, and hospital supplies in a hospital of this type in California were solved by a simple improvisation. To the metal frame laundry basket (Med. Dept. Item No. 70035) were affixed two 3-inch swivel-type steel casters and two 3-inch rigid-type steel casters. With a laundry basket, Army, duck body (Item No. 70030) in place within the metal frame, the basket was used as a delivery and collecting cart throughout this installation. A total of 132 casters with flat steel plate was ordered from the Colson Equipment Company through the San Francisco Medical Depot at a cost of $1.00 each for the swivel type and 81 cents each for the rigid type. The catalog price of the duck body for the basket was $2.33, and for the metal frame, $2.60, making a total cost of $8.55 for each utility carrier. Capt. Aram A. Rustigan, M.A.C., medical supply officer, states that the service realized by this improvisation is worth far more than the cost in the saving of time and effort. Experience had shown that the soiled linen



conveyor (Item No. 70490) was not satisfactory, as it tipped over easily on rough surfaces, floors, and street crossings, and the small casters caught in cracks between boards in the ramps and in splinters from the soft wood floors in the hallways. The clean, folded linen became crushed in accidents so frequently that one attendant could scarcely complete a linen exchange trip without a mishap. The three platform trucks (Item No. 79405) allowed for an installation of this size were inadequate and were not available for warehouse use. The hospital post office had no conveyor for handling the large volume of mail. With the laundry basket equipped with the large casters these problems of transportation within the hospital were solved. The arrangement has been of such benefit that the idea is passed along for consideration and possible installation in other cantonment-type hospitals.

ADHESIVE STRAPPING FOR RELIEF OF ACHILLODYNIA

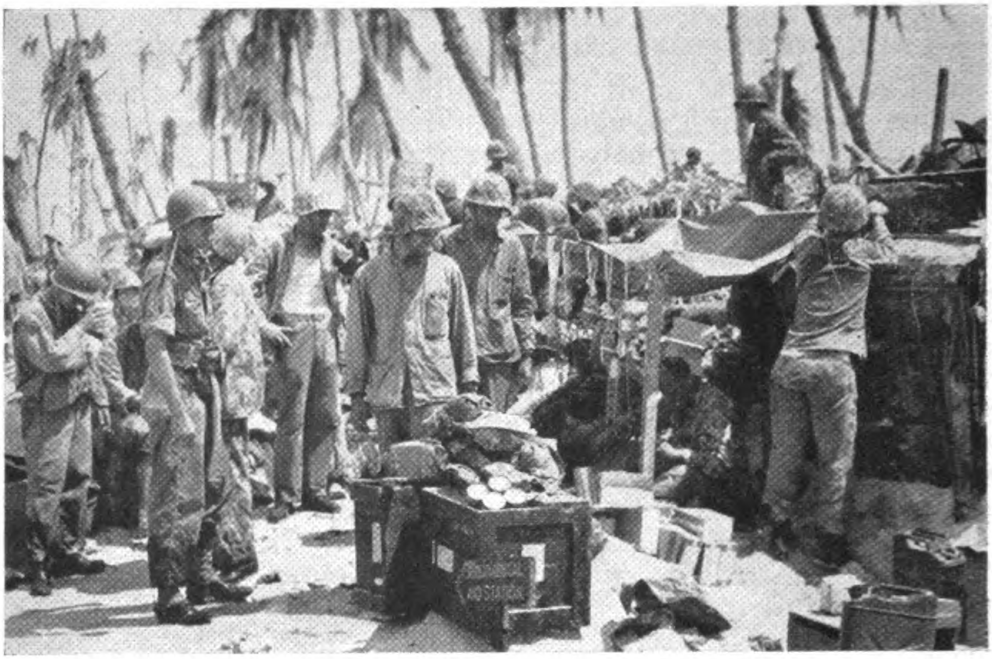
Painful irritation of the Achilles' tendon, and of the small bursae surrounding it, near its insertion into the calcaneus has been observed frequently in recruits. It is caused by the transition from low civilian shoes to G.I. shoes coincident with the increased amount of marching required in the Army. The irritation apparently is caused by the constant pressure of the counter of the high shoes on the insertion of the tendon and is characterized by extreme pain and tenderness above the heel with every step of the affected foot. Examination may be negative except for the tenderness or reveal reddening, swelling, and crepitation on movement of the foot.



Captain Paul J. Reinsch, M.C., reports that the irritation disappears with rest which can be supplied by strapping the foot and leg in a manner which relaxes the Achilles' tendon. Three long 1-inch strips and four short strips of adhesive tape are used. Prior to strapping, tincture of benzoin is applied to the sole of the foot and the shaven back of the leg to make the tape stick. The foot is placed in moderate extension with the heel 1 inch off ground with ball touching and leg perpendicular. The three long parallel strips run from the metatarsal arch over the heel to the middle of the back of the calf and are anchored by four short crosspieces over the ball of the foot and the heel, above the ankle and the calf of the leg. Following strapping, the patient should be cautioned to step gingerly for a few minutes to allow the tape to stretch slightly. Instruction should be given

to lace the shoes only to the third eyelet from the top to relieve some of the pressure causing the disease. The tape is allowed to remain for three to four days by which time the condition usually has cleared. Restrapping may be used in recalcitrant cases. In no case was hospitalization resorted to at this dispensary. Most individuals expressed immediate relief and complained only of the initial pulling of the tape on the skin of the calf.

All cases seen and treated in this manner were acute new cases. Treatment was given before any trophic changes had a chance to develop. Relaxation of the tendon was obtained by the strapping which proved sufficient to cure these early irritations causing the achillodynia. The patient is ambulatory and in most cases can carry on full field duties.



First-aid station established soon after landing at an island in the Pacific. Official Marine Corps photograph.

JOINT MEETING OF RADIOLOGISTS

The Radiological Society of North America and the American Roentgen Ray Society will hold a joint meeting at the Palmer House, Chicago, 24-29 September 1944. Interested medical officers of the Medical Department of the Army are invited to attend. The executive director of the joint meeting is Dr. Donald S. Childs, 713 East Genesee Street, Syracuse, New York.

Litter bearers carry a wounded soldier five miles from fighting front on New Georgia into the advanced first-aid station; from there on, wounded men are transported by jeeps and boats. Photograph by U. S. Army Signal Corps.

FOOD IN JAPAN

Except for the staple articles of food such as rice, wheat, barley, and certain fruits and vegetables, Japan normally has little food in excess of local needs. Large quantities of staple foods must be imported. As the fertilization of farms and gardens with night soil is a common practice in Japan, all vegetables and most fruits must be thoroughly washed and cooked before eating; otherwise, there is great danger of contracting typhoid fever, paratyphoid fever, bacillary dysentery, amebic dysentery, cholera, or one of the many forms of parasitic infections. Shellfish and fish are frequently infested with flukes and other parasitic worms. The native custom of eating raw fish is responsible for the spread of the fish tapeworm, *Diphyllobothrium latum*. Certain poisonous fish are found in the water about Japan, such as the toad fish, *Tetrodon maculatum*. The dairy industry is confined to the environs of a few of the larger towns; although there is some attempt at control of bovine tuberculosis, there are no pasteurization plants to ensure safe milk.

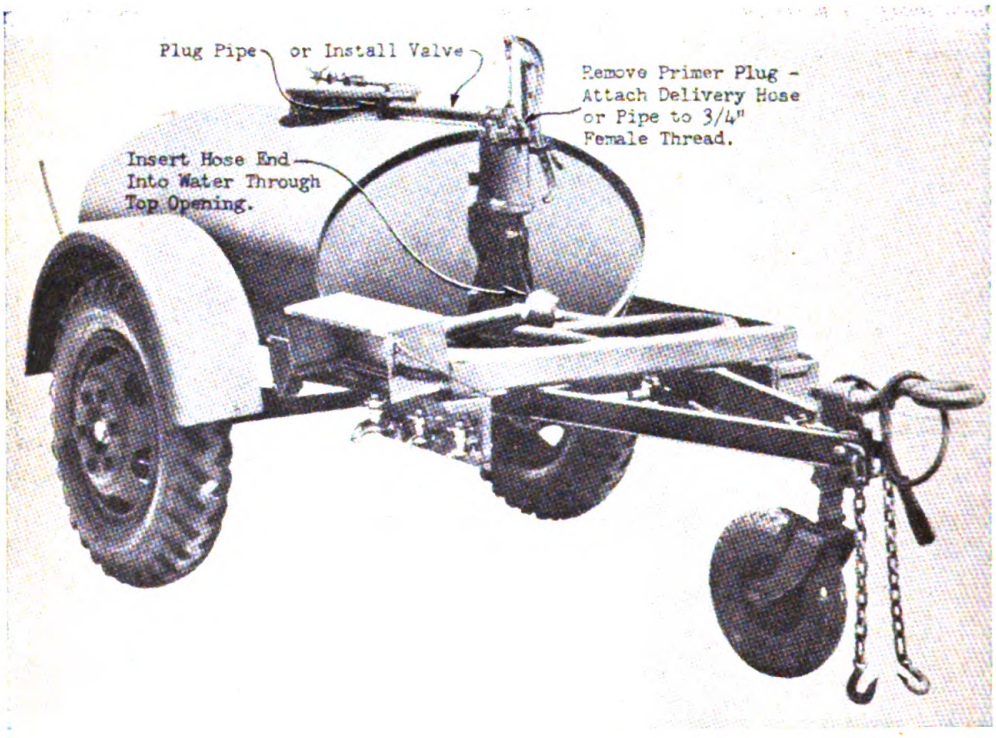
WATER TANK IMPROVISATIONS

Modifications of the 1-ton, two-wheel trailer, water tank, 250-gallon, have been reported from the field by Lieut. Colonel H. A. Schulze, M.C. With these modifications, the trailer water tank will provide additional facilities for an emergency fire-fighting apparatus, a water supply for improvised shower baths, and water pressure for any piped supply that may be needed. To make the modifications, three operations are required:

a. Provide a method to stop water passing from the pump into the tank. This may be done by plugging the pipe or installing a valve.

b. Attach the delivery hose or pipe through which water is to be delivered to the primer hole threads.

c. Insert the hose end into the water in the trailer through the top opening.



Army Nurse Awarded Soldier's Medal.—The War Department announced on 5 February the award of the soldier's medal to First Lieutenant Orah D. Stephenson, chief nurse, Station Hospital, Morris Field, Charlotte, N. C., for heroism in the rescue of a nurse from a burning building. Lieutenant Stephenson fought her way through flames and smoke and dragged an unconscious nurse to safety, herself receiving burns about the face and hands and being partly overcome by smoke. Lieutenant Stephenson was born at Sioux City, Iowa, entered the Army Nurse Corps in 1940, and is the third Army nurse to receive the soldier's medal.

SUGGESTIONS FOR LABORATORIES AND DISPENSARIES

1. To guard against accidentally dropping a glass graduate when your fingers are wet or greasy, attach two strips of wide adhesive tape on opposite sides of the graduate. These will provide enough friction to prevent slipping and when it is desired they can be removed quickly.

2. For storing microscope slides, a cardboard holder can be made easily. Use a piece of thin cardboard 5 inches square. Draw a line across it 1½ inches from one end and fold it along this line. At 1½-inch intervals staple the folded cardboard, beginning ¼ inch from the edge. The staples should be at right angles to the fold and about ½ inch from it. If stapling machine is not available, a needle and thread will serve the purpose. Holders for more slides can be made by adding 1½ inches to the width of the cardboard for each extra pocket.

3. When washing windows it is a good idea to dry them on the outside by stroking the cloth up and down, and on the inside by stroking the cloth horizontally. Then, if there are any streaks you can tell at a glance whether they are inside or outside the window.

4. Surplus electric cord lying on the floor can be wound on an empty adhesive-tape reel. One side of the reel is bent outward to permit passage of the cord when the reel cover is replaced. If there is room under the lamp base, the reel can be placed under it out of sight. However, if the reel must lie on the floor, it can be painted to match the floor and so will not be conspicuous.

Submitted by Second Lieut. Louis J. Brown, M.A.C., from a staging surgeon's office.

MEDICAL DEPARTMENT ART PROJECT

The Army Medical Purchasing Office has initiated a project whereby Medical Department activities in World War II are being recorded in the fine arts. Fifteen of the country's best known painters are or soon will be engaged in providing a collection of some 300 oil paintings, wash drawings, water colors, and sketches depicting the more important phases of the Medical Department's work. While the primary objective is a graphic record of the Department's activities during the war, it is planned to use this material also for general publicity to be obtained by traveling museum exhibits and by releases through the weekly press.

Artists are already overseas in several theaters, some having been present at four combat actions including the landings on the Admiralty Islands. Another artist on completion of oil paintings of the hospital train presently will be sent to South Pacific installations. In the zone of the interior the following subjects are thus being covered: the training of medical officers at Carlisle Barracks, the training of enlisted

men at Camp Barkeley, the rehabilitation of the wounded at the Halloran General Hospital, the training of Army nurses as observed at Camp White, the Army Medical Center, the Office of The Surgeon General, the production of medical supplies and equipment, and the movement of men and matériel. A large painting of The Surgeon General and twelve members of his staff is expected to be the only portrait in the program. The completion of the project must await the return of the artists from overseas and several months' work in the studio, and it is unlikely this will be before the end of 1944.

This valuable record, a gift to the Medical Department by the Abbott Laboratories of Chicago, is being administered by the Associated American Artists of New York. Abbott Laboratories has through the same association given to the Treasury Department the art work for War Bond posters and has presented to the U. S. Navy a similar although smaller record of naval aviation.

The War Department had for some time an over-all art program employing civilian artists in overseas theaters. Those artists were not instructed to paint any specific phase of the Army's efforts but to paint what they saw and felt worthy of recording. The Congress, however, has prohibited the use of federal funds for this purpose and the War Department has had to discontinue its art program.

Jungle-type bed used by a portable hospital detachment. Australia.

EOSINOPHILIC PNEUMONIA

W. Löffler in 1931 described several cases of transient pulmonary infiltration associated with eosinophilia[1] and later noted that the chest x-ray changes were more marked than the clinical findings. The x-ray appearance of the lungs varied, the lesions being multiple, small, large, or annular and affecting one or both sides. The eosinophilia varied from 10 to 50 percent and reached the maximum after the pulmonary changes had diminished. Löffler suggested an allergic basis for the condition he described. Von Meyenburg made postmortem examinations on four patients who died of nonrelated causes while suffering with Löffler's syndrome showed eosinophilia in the bone marrow as well as in the circulating blood, and described a large number of eosinophils in the pulmonary tissue. Other cases have since then been reported.

A case of eosinophilic pneumonia was recently reported to The Surgeon General's Office by First Lieut. Sidney Scherlis, M. C. The patient, a farmer 24 years of age, had always been in good health until awakened last November with chilly sensations followed by headache, nonproductive cough, and malaise. He had been in the California desert area last summer. A roentgenogram showed diffuse soft changes throughout both lungs. His temperature went as high as 101.4° F. during the first three days and fine rales were noted in the left axilla on the fifth hospital day. The chest condition cleared up gradually and by the tenth hospital day the lungs were completely cleared with no evidence of residual infection. The most striking observation was that the patient did not appear as ill as the extensive x-ray changes would lead one to expect. The leukocyte count was 15,500 the day after admission to the hospital with a relatively high percentage of polymorphonuclears and nonsegmented neutrophils, but three days later with the fever subsiding, the total leukocyte count was apparently normal. However, an eosinophilia of 22 percent had developed and on the eighth hospital day reached a maximum of 33 percent, at which time the patient was apparently well, although the x-ray chest findings did not entirely clear until two days later. The eosinophilia, which on the twenty-fourth day was 28 percent, gradually decreased, reaching normal during the patient's sixth week in the hospital. The author likewise believes that Löffler's syndrome represents an allergic phenomenon in which the lungs are the site of the allergic reaction, that is, the "shock organ." His patient, however, gave no family or personal history of allergy and his parents and five brothers were living and well. All of the four factors comprising Löffler's syndrome were present in this case: (1) signs of pulmonary disease by auscultation and percussion; (2) changes in the lungs shown by x-ray examination; (3) transience of pulmonary signs; (4) increase in the eosinophils of the blood. (Abstract of an article

1. Beitr. z. Klin. d. Tuberk., 79:368-382, February 1932.

entitled, "Löffler's Syndrome—Eosinophilic Pneumonia—Case Report," by First Lieut. Sidney Scherlis, M.C., assistant in medicine, Johns Hopkins Medical School, on leave of absence.)

ANNUAL REPORT ON HOSPITALS

Patients entered hospitals in the United States at the rate of one person every two seconds during the year 1943. The number of patients admitted reached a total of 15,374,698. In this period 11.6 percent of the entire population of the United States based on the 1940 census received inpatient hospital care. There were in addition 1,924,591 hospital births, an increase of 253,992 over the previous year. The number of hospital beds in the 6,665 registered hospitals was 1,649,254, an increase of 265,427 beds over the previous year or an equivalent of a new 727-bed hospital for each day of the year. The greatest gain in hospital admissions naturally was in the Federal group to which admissions increased by 2,356,885. The state, county, and municipal hospitals had a decrease of 103,733, while the non-Governmental group comprising the church-related institutions, other nonprofit associations, and the proprietary hospitals had an increase of 575,936 admissions. These facts and an amazing amount of other data compiled by the Council on Medical Education and Hospitals were published in the *Journal of the American Medical Association*, 23 March 1944.

In the non-Governmental group of general hospitals, the patients had an average stay of ten days. The average length of stay in the Government hospitals was nineteen days, the same as for the previous year.

The registered hospitals employed 113,424 graduate nurses on nursing service, 13,167 other graduate nurses, 17,309 practical nurses, 38,801 nurses' aides, 92,427 attendants, and 31,140 orderlies. The number of graduate nurses employed for nursing service decreased during the year by 6,690, practical nurses by 4,852, and attendants by 1,706; the number of orderlies, however, increased by 5,283. The number of student nurses enrolled in accredited nursing schools was 110,222, an increase of 12,056 over the previous year. The *Journal* said that the hospitals of the United States continue in war as in peace to render faithful and efficient service to the sick and injured of the nation, although many of them operate with reduced staffs in their various departments. "Their accomplishment in the face of these difficulties reflects a high degree of standardization and also initiative, pride of occupation, loyal cooperation, and devotion of those who serve the sick. By careful administrative management, coordination of services, and skillful use of available facilities and personnel, the increased demands of the wartime period have been met."

ANOTHER DENTAL SURVEY PROCEDURE

The following procedure for a dental survey submitted by Colonel L. W. Maly, D.C., has proved successful in his particular command. Colonel Maly's assignment is with an Air Forces unit. Several other plans have been submitted, all of which were declared successful. The Dental Division of The Surgeon General's Office has endorsed no single plan, since the size, type, plans, and training vary in different commands.—Ed.

The problems of maintenance of an accurate dental classification of military personnel at large military installations are well known to station dental surgeons. Many plans have been tried, some of which have worked satisfactorily. Survey sheets containing long lists of names are difficult to file; they become soiled and illegible from frequent handling and much time is lost milling through them in search of names for changes in classification.

The system or plan presented here, as far as can be determined, originated with Lieut. Mitchell M. Cohen, D.C., who made the suggestion to the post dental surgeon, who, in turn, gave it a thorough trial. The plan has been in effect at this station for three months. The whole system revolves around the use of a 3- by 5-inch card, ruled on one side, which is an item of issue and which, in fact, is a marked departure from the conventional system of survey roster sheets.

A cabinet for the cards is constructed in units of two drawers, with an outside measurement of 15¾ inches by 13¾ inches by 5 inches. Each drawer will hold about 1,400 cards. At this station 28 units are required to cover the survey of this command.

Operation and Procedure

The attractive features of this plan are its simplicity, accuracy, and ease of maintenance. However, the success of this plan depends on the efficiency of the survey officer and his assistants, the prompt and efficient action of all dental installations in reporting to this office the daily changes of classification, and the prompt and daily receipt of all personnel changes from the camp headquarters, whether on, off, or within the camp. The personnel of the dental survey office comprises one dental officer as camp dental survey officer, one corporal, one private (WAC), and one civilian clerk.

The 3- by 5-inch cards are available to every organization in the service. When the dental survey officer is notified that a group is to be surveyed, he requests that the name, rank, organization, and date be typed on the first ruled line of this card for every man in the organization. Each man is then given his own card, and the men are assembled in the usual manner before the survey officer. It is not necessary that the men be identified, their names announced, or that they be lined in a specified order. Obviously, much time and confu-

See April Bulletin, page 18.

sion are saved at this point. The survey officer announces the classification of the man, and his assistant immediately records it on the first line in the right-hand corner. This process continues quietly and quickly. At the termination of the survey, the cards are all assembled and taken to the survey office. The cards of men who are absent are given to the survey officer. A notation, "Unclassified," is recorded on the card.

In the survey office the cards are sorted alphabetically in their particular classification and filed in that order, indexed as to classification and organization. Whether the units are many or few, large or small, the procedure is always the same.

The files are maintained in the following manner:

1. Classification, Officers.
2. Classification, Enlisted.
3. Unclassified, Officers and Enlisted.
4. Shipped, Officers and Enlisted.

As the daily changes of classification are received from the dental services, the survey office assistants remove the card from the file and effect the change, lining out the original classification and inserting the new one immediately under it and returning the card to its new index.

The data with reference to transfers, off or within the camp, are taken off the changes in personnel received daily from S-1. If transferred off camp, the notation of "Shipped" is typed on the lower left-hand corner of the card with the date and it is then put in the "Shipped" file. If merely transferred to another organization on the field, the card is pulled, the proper notation to that effect noted, and the card returned to its new place in the file.

Absentees are filed alphabetically, under the organization heading in the "Unclassified" file which is placed in the rear of the classification file of this unit. If this number is small, they are pulled for appointments, a few each day, until entirely absorbed. If this number is large, the cards are sent to the unit concerned for distribution to the parties involved, with the time and place noted for another survey.

All appointments are made from the survey office. A list is made each day from the survey files, in triplicate, of the men who are to be sent to the clinic for treatment. They are selected as to priority previously announced and according to their classification. One copy is sent to the organization concerned, one to the clinic, and one for file. This appointment list is a mimeographed form, especially drawn up for this purpose, and is sent by runner to the persons concerned. Appointments for permanent personnel are made by phone and a list drawn up in duplicate, one copy for the clinic, the other for file. The men are sent in groups at specified periods as stated on the "Appointment List." All cards of the men involved are pulled from the files and notations of their appointments recorded and returned to the file. All reappointments are sent

up daily to the survey office, cards pulled, and the appointments recorded. All cards are routinely checked to ascertain whether the patient has appeared for his appointment, that he has been reappointed at a reasonable interval, or if he has not been reappointed and not classified as IV, he is placed on the appointment list to be sent in again.

Because of the transitory nature of some groups, dental survey cards are not maintained on them. However, the camp survey officer does maintain a record of their classification changes for the dental examiner who is on duty with this group. It is the responsibility of the dental examiner of this group in his daily processing of new arrivals that he submit to the commanding officer a list of all his men having dental defects. All Class I's and ID's in addition to being reported are sent immediately to the dental clinic for treatment. The clinic also will call daily for the number of Class II cases which they can treat, specifying the hour such patients are to report.

A card file is maintained and operated for officers and warrant officers as it is for enlisted personnel. All flight officers' names for examination are secured from the flight surgeon's office, and cards immediately prepared. After the examination by the flight surgeon and his staff, the dental classification of each officer is forwarded by the dental examiner on duty to the survey officer, who abstracts this data to the survey card of the officer concerned. Appointments are made by phone direct with the officer concerned.

Remarks

This system has many advantages over the roster sheets: 1. The survey is not made on the wrong man. 2. It is possible to tell at a glance on a "pulled" file the approximate number of Class I's, Class ID's, and Class II's of any unit. 3. Important data can be added to this card from time to time. 4. In making up monthly reports for the dental surgeon, the information required by paragraph 4, M.D. Form 57, is greatly simplified. 5. The classification of any unit and the whole command can be determined almost immediately by a glance at the files.

EDUCATIONAL MATERIAL ON VENEREAL DISEASE

The Surgeon General's Office has been designated as the War Department agency charged with the selection, procurement, and distribution of venereal disease educational materials (Circular No. 28, W.D., 20 January 1944, as amended by section VIII, Circular No. 98, W.D., 8 March 1944). The Adjutant General's Office, however, will distribute the pamphlets "Sex Hygiene and Venereal Disease," "Off to a Good Start," W.D. Pamphlet 35-1, "Venereal Disease Overseas," and "It Doesn't Pay," as formerly. It is not the intent of the War

Department to prohibit production by posts, camps, and stations of supplementary educational material to meet local needs.

Venereal disease films will be obtained through customary training film channels as previously. A new training film to be called "Pick-Up" will be available 1 July. Three new films, "For Your Information," "The Magic Bullet," and "Fight Syphilis," have been approved for showing to members of the Women's Army Corps. The first one, which is in color, has a tentative release date of about 1 June.

A new poster program with a schedule of one poster each month has been instituted. The posters will be selected, purchased, and distributed under the direction of The Surgeon General's Office and shipment to installations of more than 500 persons will be made direct to the surgeon of the installation. Smaller posts are to be supplied from an allotment of posters made to the surgeon of each service command. New venereal disease educational pamphlets are also in process of preparation. These include a furlough pamphlet, a new pamphlet on venereal disease overseas, and a pamphlet for members of the Women's Army Corps.

RECENT DIRECTIVES AND PUBLICATIONS OTHER THAN S. G. O.

This list is intended only as a brief reference to items mentioned. Before acting on any of them, the original communication should be read. Requests for copies, when made, should be directed to the source of the communication through proper channels.

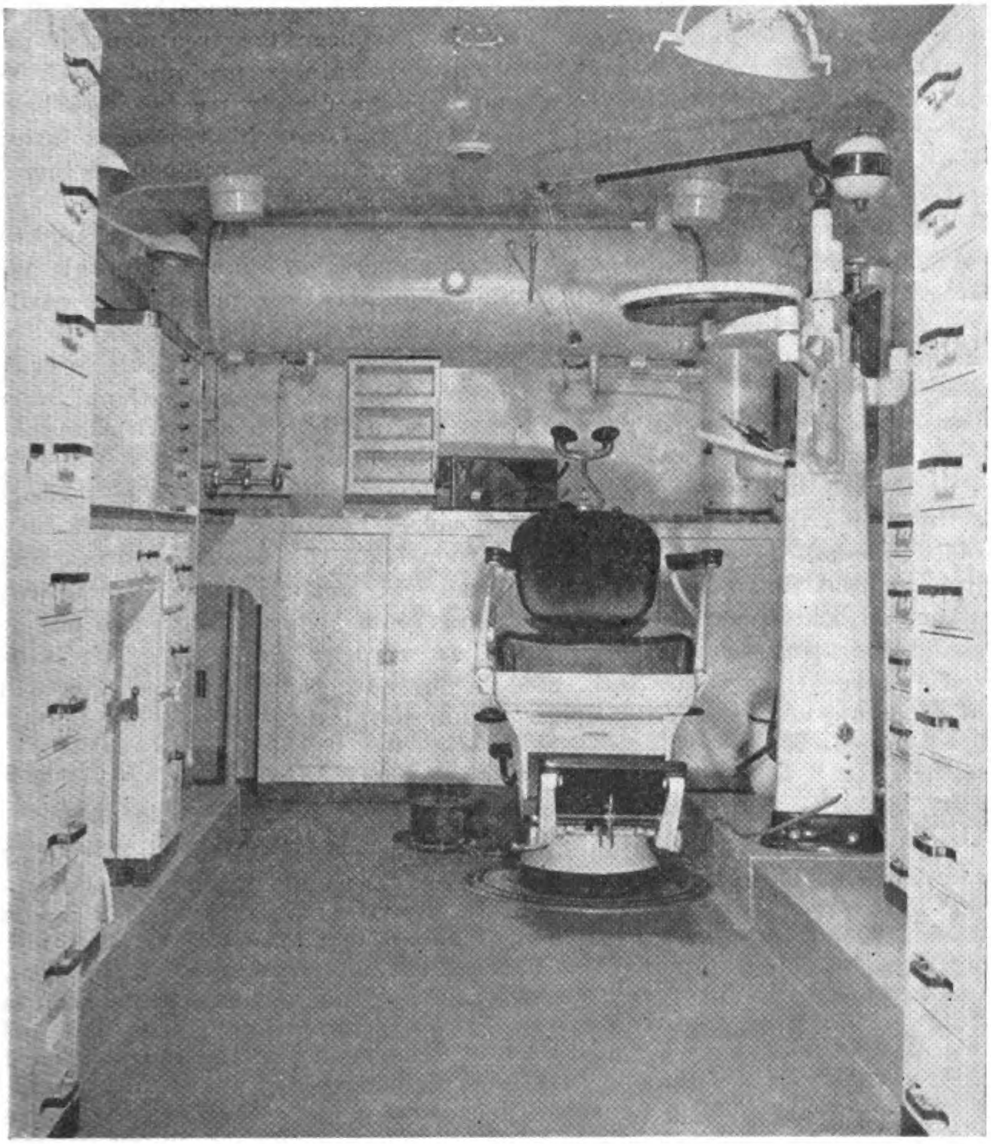
W. D. Circular No. 102 11 March 1944	Officers—Physical Standards for Oversea Assignment. General service officers are considered qualified for oversea service unless disqualifying defects have become apparent since physical examination that established their general service status. Limited service officers are qualified for oversea service provided their defects are static and not subject to development of complications.
JAG Bulletin No. 2. Vol. III, Feb. 44	C. O. of Army hospital has authority administratively to restrict freedom of action of patient or to restrain him, provided such restraint is not imposed as punishment or for disciplinary reasons, but is a reasonable and necessary incident of proper medical care and treatment of such patient. The fact that a patient is incorrigible, or that his conduct sets a bad example for other patients, does not in itself and in the absence of justifying medical considerations, warrant such action.
AR 615-360 C 19 17 March 44	Discharge.—Provides that where enlisted patient at station hospital is to appear before CDD board, officer authorized to discharge will direct transfer of such patient to station complement or detachment of patients of the post, camp, or station where patient then located, and patient will be carried as surplus in grade until disposition of his case.

GAO Daily Synopsis of Decisions 15-18 Mar. 44 B-39424	Officer is entitled to increased rental and subsistence allowances because of dependents (wife) even though wife is student in U. S. Cadet Nurse Corps and is receiving "maintenance" from an institution which is reimbursed by Government for expense of such "maintenance."
WD Circular 109 16 March 44 Sec. IV	When temporary duty at a place other than old or new permanent station is directed in permanent change of station order, the order may prescribe per diem, and per diem will be paid for all travel and temporary duty performed under the order in accordance with rules prescribed in par. 3, WD Cir. No. 60, 1944.
WD Circular 113, 20 March 44 Sec. VII	All travel orders authorizing recurring trips on mileage basis and issued prior to 1 March 1944 and extending past that date will be cancelled and new orders issued authorizing payment of per diem. Purpose is to place temporary travel on uniform basis and in accordance with WD Cir. No. 60, 1944.
WD Supply Bulletin SB 8-3 21 Mar. 44	Sets forth the policies and procedures for procurement, storage, issue, and requisition of Medical Department professional books.
WD Technical Bulletin TB Med. 22 21 March 44	Fractures, Reduction of. Provides instructions for cases where x-ray fluoroscopy is used during act of reducing fractures.
ASF Headquarters Circular 84 25 March 44 Part 1, Sec. II Part 2, Sec. VII	Inspector General Reports. Directs that action be taken to reduce time consumed in processing Inspector General Reports and requires adherence to ten-day time limit prescribed in par. 13 AR 20-10. Veterinary Corps—Meat Inspection.— W. D. has agreed with War Food Administration to provide veterinary personnel to inspect meat at certain cattle-slaughtering plants where Federal Meat Inspection Service cannot supply meat inspectors.
WD Circular 122 28 March 44 Sec. V.	Patients who entered military service in Hawaii and are hospitalized in U. S. are to be disposed of as follows: (1) those who will be returned to duty to remain hospitalized in U. S.; (2) those who are to be discharged and require no further hospitalization, to be returned to Hawaii for separation; (3) those who are to be discharged and require further hospitalization after discharge, to be returned to Hawaii, transferred to Veterans' Administration, and discharged; (4) those requiring specialized treatment not available in Hawaii, to be retained in U. S.
AR 605-250 28 Mar. 44	Retiring Boards. Supersedes AR 605-250, 1 June 1943, and changes thereof. Makes provisions re jurisdiction, composition, general duties, and findings of Army Retiring Boards.
AR 40-550 C 2 29 March 44	Provides that where dispensaries are equipped with beds for temporary care of patients such patients will be carried as on "quarters" status, and days lost will be considered days lost in quarters.

WD Technical Bulletin TB MED 28 1 April 1944	Makes provisions re "Treatment Programs for Psychiatric Patients in Station and General Hospitals."
WD Circular 127 1 April 44 Sec. VI	Films of accepted enlisted personnel which have accumulated at Army examining stations will have necessary identifying data recorded thereon and will be forwarded to Veterans' Administration, Washington, D. C.
WD Training Cir. 22 1 April 44	Sets forth detailed program of instruction on venereal diseases and their control. Instruction to be given to all military personnel.
WD Circular 125 30 March 44 Sec. VIII	C.O.'s will make available to military personnel venereal disease prophylactic items prescribed by S. G.—C. O.'s of companies and detachments authorized to purchase such items with unit funds from medical supply officers. Such items to be issued to individuals at cost or without cost according to instructions of unit commander. Army exchanges to sell prophylactic items of type prescribed by S. G. and no others.
WD Circular 130 4 Apr. 44 Sec. III	Dental Laboratory Technicians to be assigned only to listed units scheduled for oversea service in the number specified.
ASF Headquarters Circular 93 4 April 1944 Part 3, Sec. VIII	Hospital Convalescent Centers. Requires study to be made in each service command and Military District of Washington with view to establishing convalescent facilities for care and treatment of patients in general hospitals who do not require current hospital treatment. Where such facilities are not available adjacent to general hospital. hospital convalescent centers should be established to receive patients from a number of general hospitals. Inclosures Nos. 1 and 2 set forth plan of convalescent facilities and possible sites available.
AR 605-115 C 7 5 April 44	Leaves of Absence. W. D. policy is that officers be returned under rotation directives rather than for leave of absence and return to oversea commands. Return of officers to be limited to emergencies, except when conditions in an oversea command justify and transportation facilities permit. Establishes policy in cases where exceptions to above policy are authorized.
ASF Headquarters Circular 95 6 April 44 Part 2, Sec. III	Requires all physical therapy aides under 45 years of age to be familiar with subjects set forth in course of Basic Military Training for Nurses. Deletes certain professional subjects set forth in nurses' training program and substitutes certain professional subjects in which physical therapy aides are to be instructed.
WD Circular 140 11 April 44	Makes provisions re hospitalization and evacuation of personnel in the zone of interior. Sets forth general policies and instructions re responsibilities of various commanders, types and functions of hospitals, bed capacity, transfer and transporting patients, medical regulating services, hospital funds, medical statistical reports, and personnel strength tables.

NEW MOBILE DENTAL OPERATING UNIT

The new Mobile Dental Operating Unit developed at the Medical Department Equipment Laboratory, Carlisle Barracks, Pennsylvania, is designed and fully equipped to do all dental operation procedures such as fillings, extractions, and impressions for dentures in the combat areas. The unit is a standard Ordnance, 2½-ton, 6x6 truck, with special body fitted with



Interior view of unit.

water tanks, hot water heater, sink, plumbing, electric wiring, lights, supply cabinets, operating chair, unit, and lamp.

This mobile unit will be operated by one dental officer and one dental technician and will be used in isolated areas and with military organizations that do not have a dental officer assigned.

Correspondence

HECTIC BUT INTERESTING

The following letter was addressed to an officer in the Surgery Division of The Surgeon General's Office.

We have been very busy at times and since arrival have had about 475 cases. I have yet to close a wound primarily, a turnabout from my original attitude. We are only two miles from the front line. The cases are seen early after injury, but limited space necessitates early evacuation. The opportunity to treat wounds early accounts for the good luck we have been having. The most difficult problem has been the treatment of patients with shattered pelves, who are and remain in profound shock so that associated visceral injuries cannot be immediately treated. We have had seven such cases with some mortality, but I can think of no solution even in retrospect, unless the shock be ignored and operation done immediately. And yet that does not seem reasonable.

Since our medical dumps were destroyed on two successive nights, Tojo must think we are an ammunition dump rather than a hospital. We are getting good service on replenishing supplies. Even penicillin is easily available. A radiogram brings over a four-motored bomber that drops one lone parachute with penicillin. Its effectiveness, as yet, is difficult to evaluate, but we have had no gas gangrene, although several patients were ideal candidates for same. The patients are drifting in now with dengue, fevers of undetermined origin, and fungus infections.

Although hectic, this experience has been interesting. The doctors at times find themselves towing-in floundered assault cavalry barges. We landed one-half hour after the first troops and the land opposition was minimum, but that was made up in part by air activity. The hospital was bombed with a direct hit on the operating room. We now have two underground operating rooms and four similar wards. This in turn has initiated a wave of inspectors interested in our novel setup. I hope they will not be erroneously inspired to plan similar hospitals, but have my doubts.

CARBON TETRACHLORIDE POISONING

New York, Feb. 28, 1944.

To the Editor:

In studying the literature on occupational injuries due to inhalation of organic solvents, we came across a report on "Carbon Tetrachloride Poisoning," by Perry, in the *Army Medical Bulletin* of October 1942. This report mentioned that in 1938 six firemen of the Detroit Fire Department lost their lives as the result of demonstrating extinguishers of a certain type. We were unable to find any other reference to this accident and therefore wrote to the Detroit Fire Department for information. Under date of November 29, 1943, we were advised by the Secretary of the Detroit Board of Fire Commissioners that no such incident had ever occurred.

After further correspondence with various persons concerned, we were able to locate the Safety and Fire Protection Engineer to whom the original report had been attributed. In a letter received on February 14, 1944, he disclaims any knowledge of such an incident but suggests possible confusion with a trade paper article which he had given the author and which mentioned a case attributed to an oil field worker's use of a three-gallon extinguisher on a motor fire.

L. W. Hutchins, Director, Safety Research Institute,
420 Lexington Avenue, New York, N. Y.

Special Articles

Debridement–When and How Much?

A Comparative Study of Battle Casualties

LIEUT. COLONEL CLARENCE W. MONROE
Medical Corps, Army of the United States

In the minds of many surgeons, débridement should be accomplished at the earliest possible moment and, especially in the case of extremities, should be a sufficiently radical procedure to explore the depths of the wound, removing all devitalized tissue, foreign bodies, and detached bone fragments, and allow complete and adequate drainage. Most surgeons treating war wounds would adopt this procedure whenever the patient is seen. Fruchard[1] on the other hand draws a distinction between "épluchage" and débridement. The former is essentially the procedure just cited which he feels should be done only in the first 48 hours after injury. He defines débridement as the simple excision of the skin margins of the wound and the establishment of drainage. This he states is all that should be done after 48 hours. Ferguson, Brown, Nicholson, and Stedman[2] on the other hand state that with the local use of sulfathiazole radical débridement appears unnecessary and in many cases actually destructive. In reporting on the treatment of 4,000 battle casualties aboard a hospital ship they make the following statement, "Bullets often caused no more trauma than might be expected if an ice pick were suddenly thrust through a part and pulled out. Into these simple wounds sulfathiazole was sprayed and a pressure bandage of elastic webbing applied. A patient with a through and through wound of the leg or thigh was usually able to be up and walking four to five days after injury and the wounds healed in seven to ten days. We have not seen a single case of infection develop in a patient treated in this manner." Perhaps the type of spray used by these writers accounts for the difference in their results. Certainly their experience cited in the last line of the quotation has not been shared by many others. Kessler[3] reporting on 1,650 battle casualties encountered 36 cases of gas gangrene, an incidence of 2.18 percent. He makes the significant statement that "gas bacillus infection did not develop in any wound on which thorough débridement had been done."

1. Fruchard, H.: Treatment of Recent War Wounds; French and Spanish Methods, Lancet, 1:725-7, June 1942.
2. Ferguson, L. K., Brown, R. B., Nicholson, J. T., and Stedman, H. E.: Observations on the Treatment of Battle Wounds Aboard a Hospital Ship, U. S. Nav. M. Bull., 41:299-305, March 1943.
3. Kessler, Henry H., et al.: Activities of the Orthopedic Department at a U. S. Naval Base Hospital, U. S. Nav. M. Bull., 41:1,540-56, November 1943.

The author had the privilege of sharing in the activities of the surgical staff of an evacuation hospital during two campaigns in the Southwest Pacific. The first campaign covered a period of two to two and one-half months during which time practically all the troops involved lived on "C" rations. Because of supply problems even these were difficult to obtain at times. The tactical situation required many of the troops to make long jungle marches on short rations before making any contact with the enemy. Casualties did not begin to occur in any considerable numbers until the campaign was about three to four weeks old. When they did occur the great majority were seen within four to six hours of injury by small surgical units very near the scene of action. These units had been directed to thoroughly débride and splint extremity wounds. Abdominal wounds were to be operated on as soon as the patient was considered in adequate condition for the procedure. Following surgery these patients were moved to the rear as early as their condition would permit. The journey included carry by native litter, jeep, plane, and a five-mile ambulance ride to reach our hospital. On the average they arrived about 48 hours after injury.

On arrival all were lean, thin, almost bordering on emaciation, but comparatively few of them were very toxic. A large percentage had had sulfa drugs orally in amounts sufficient to produce a very mild cyanosis. About 10 percent of them required further or a primary débridement because of inadequate drainage from their wounds resulting in some toxemia. Most of the chest cases and some of the compound fractures, even though adequately débrided, were toxic. In the 1,203 battle casualties encountered in this campaign there were ten cases of gangrene of which eight were due to bacterial agents, the other two to blood vessel injury. This was an incidence of 0.66 percent for bacterial gangrene.

There were 14 deaths in this group of cases which were distributed as follows: gangrene, 4; abdominal wounds with peritonitis, 4; chest wounds with pneumonia or septicemia, 3; brain wounds with meningitis, 2; and extensive face and neck wound followed by septicemia, 1.

The second campaign lasted three to four weeks. The troops involved were moved out of an area where diet was adequate and within four days the first casualties were back at the hospital. These men were fed on "K" ration during the campaign—a recently developed and more adequate diet than "C" ration. The medical setup in the forward area was quite similar to that of the first campaign in location and equipment. There were probably not quite so many well-trained surgeons in these units as in the first campaign. However, the surgeon in charge of the medical service in this campaign ordered his medical units to treat extremity wounds by the application of sulfanilamide crystals, a sterile dressing, and

adequate immobilization. Any further treatment required in such extremities was to be given in the rear areas. He made the statement in my presence that he believed only in a very conservative débridement—"a slight coning of the skin wound"—but he did not permit his medical officers to do even that much. Wounds of brain and serous cavities were to receive immediately the definitive treatment indicated.

Evacuation in this campaign was from the beachhead medical units to barges, thence by a 36- to 40-hour water trip to the rear area where a ten-mile ambulance ride completed the journey to a hospital. The patients arrived on the average about 72 hours after injury. These men were well nourished, not thin and emaciated as in the first campaign. However, practically all who had wounds of any extent were quite toxic. Many had their original battle dressing still in place. Temperatures of 102° to 104° F. were the rule rather than the exception. Splinting was quite adequate except that too many men had had Collin's hitch or shoe traction applied for several days because of fractures. This procedure has never been sufficiently frowned on, in our opinion. Pressure necrosis of the dorsum of the foot with, in some cases, exposure of the tendons, is a terrible thing to add to a compound fracture.

Of the patients received during this campaign 54 percent required débridement upon admission to our hospital. There was an incidence of 4.0 percent of bacterial gangrene. To state the whole picture it must also be noted that the giving of sulfa drugs in the course of evacuation was not so successfully achieved as was true in the first campaign. All had been operated on in the forward area and each made an uneventful convalescence.

There was 0.8 percent mortality in this group. The patients reached us from two to five days (average, three) after injury; consequently there were fewer deaths in the hospital and more in transit. One death was due to gas gangrene of the left arm and a perforating chest wound with hemothorax. The patient died 30 hours after admission, never having responded sufficiently to restorative measures to permit of amputation. Another death was due to suffocation when the patient aspirated a large mucopurulent plug from a very extensive wound of the lower jaw and neck involving the larynx and trachea.

Of the cases of bacterial gangrene, 5 were of the exact type Ferguson et al. describe. They had small through-and-through perforating wounds of the extremities (3, legs; 2, arms) without any damage. None had had more than sulfa drugs and a dressing applied.

COMMENT

My experience with war wounds leads me to disagree with the statement of Ferguson et al. that bullet wounds often cause no more damage than an ice pick. I believe that high

velocity projectiles cause cellular and molecular derangements in the tissue at a distance from the site of the visible wound. In proof of this, note the tendency for war wounds to break down on suture even after wide débridement. None of us would hesitate to suture an ice-pick wound after débridement but very few surgeons who have seen much of war surgery are willing to suture war wounds, especially of the extremities. What I have chosen to term cellular and molecular derangements are reversible reactions. This is demonstrated by how readily the adequately débrided *unsutured* war wound heals without further loss of tissue. It is further proved by the success of so-called primo-secondary suture now advocated by many surgeons. In four to five days the cells bordering the wound recover from the blast effect of the high velocity projectile and are again amenable to suture.

I will grant there are occasional battle wounds which do heal like an uncomplicated ice pick wound even though nothing is done to them. However, for the surgeon who first sees such a wound to assume that such will be the case in this particular patient is unjustifiable and may lead to catastrophe. As pointed out above, 50 percent of our cases of gangrene had exactly the type of picture Ferguson describes and to which he would do nothing but spray in sulfathiazole and apply a pressure dressing. The magic sulfa wand was never intended to make the surgeon lose sight of good principles. Certainly the simple excision of the wound margins and sufficient extension of the incision to give a real look at the deeper tissues is the due of every patient. One need see only once the extensive soft tissue damage inside an innocent-looking extremity to be convinced of the wisdom of looking at every wound. Naturally after a good bit of experience with war wounds the surgeon may begin to exercise a bit of selection, but I am convinced that the man who has not seen many war wounds should err on the side of radicalism. This implies, of course, a clear knowledge of anatomy—the location of essential structures.

Undoubtedly Ferguson will reply that their mortality rate (0.18 percent in 4,039 patients) is hard to excel—a fact I readily grant. However, he states they received a few cases in twelve hours, a somewhat larger number in two to four days, and the bulk of them five to fourteen days after injury. It seems likely that those who were going to die never reached their hospital ship. More than half of our deaths occurred within twenty-four to thirty-six hours of admission, and since the average time lapse from injury to admission in our cases was two and three days respectively, our figures and Ferguson's are hardly comparable. Also, since one-third of his patients were Navy personnel, they may not have been exposed to soil on which the natives had lived with their well-known lack of sanitation. I wish only to make the point that when

casualties are coming from such areas as ours did débridement is essential to save all the limbs possible.

I have heard surgeons talk about débridement of war wounds being more satisfactory if postponed forty-eight to seventy-two hours after injury because of sharper differentiation between live and dead tissue after this interval. In the interim it is assumed that bacterial growth will be held in abeyance by large doses of sulfa drugs. This again seems to me very poor surgery. First, because there is as yet no clear proof that sulfa drugs exert any deterrant effect on the growth of clostridia which are the organisms most to be feared in war wounds. Second, because one can never count for certain on the adequate administration of sulfa drugs along the line of evacuation of the wounded. Third, because it is so easy to avoid any trouble at all by adequately opening the wound.

The two series of cases presented, perhaps, give an unfair comparison. One had in 90 percent of the cases adequate débridement and sulfa therapy; the other had no débridement and inadequate sulfa therapy. Yet the implications seem clear. The earlier and more adequately débridement is done the lower will be the morbidity and mortality rates. This does not imply criticism where medical service *cannot* be given in the forward area. But when one can adequately treat brain and abdominal wounds he is not justified in denying treatment to the patient with an extremity wound. If the paper of Ferguson et al. has led to this misconception in the minds of some surgeons, it should be corrected at the earliest possible moment.

SUMMARY

1. A résumé of one hospital's experience with the battle casualties in two campaigns in the Southern Pacific is given. The pertinent facts are:

a. First campaign: Relative long duration with food supplies short, 90 percent of casualties adequately débrided early (four to six hours), morbidity low in patients with extensive wounds, 0.66 percent incidence of bacterial gangrene.

b. Second campaign: Short duration with adequate food supply, 46 percent of casualties adequately cared for early (four to six hours), morbidity high in patients with extensive wounds, 4 percent incidence of bacterial gangrene.

2. A plea is made for early débridement which at the very least provides adequate drainage from the wound even if all devitalized tissue is not removed.

CORRECTION

Treatment of Meningococcic Infection—In the item entitled, "Treatment of Meningococcic Infection in Soldiers," in the May 1944 Bulletin, in the 19th line from the top of page 9, the dosage, 0.25 gm. should have been 0.025 gm.

Treatment and Prevention of Dermatophytosis and Related Conditions

JOSEPH G. HOPKINS, M. D., ARTHUR B. HILLEGAS, PH. D., EARL CAMP, M. S., R. BRUCE LEDIN, B. A., and GERBERT REBELL

The treatment and prevention of dermatitis of the feet, so-called "athlete's foot," is a troublesome problem in the Army. The maintenance of healthy feet and the management of apparently trivial lesions that may lead to painful skin injuries or severe secondary infections obviously are of military importance.

The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development of the National Research Council and Columbia University. The findings, which should not be considered final, will be stated somewhat categorically for the sake of brevity. Some of the recommendations, even if they seem obvious, may be of interest to medical officers.

Inflammation of the skin of the feet may result from many causes and, in any individual case, several factors may contribute to the etiology. The following are recognized:

1. *Mycotic infection.* One of four species of fungi, *Trichophyton gypseum*, *Trichophyton purpureum*, *Epidermophyton inguinale*, or *Monilia albicans* (or probable variants of these species) are found in the majority of cases of dermatitis of the feet. The Trichophyta are found also in 10 percent or more of normal feet. When the skin becomes macerated by sweat or water, they proliferate and contribute to the ensuing dermatitis.

2. *Pyogenic infection. Staphylococcus aureus* is also found in the majority of cases of dermatitis of the feet and in some is apparently the sole cause. Staphylococcus or streptococcus causes most cases of cellulitis and lymphangitis that follow dermatophytosis, although lymphangitis may result from sensitization to the Trichophyta without pyogenic infection.

3. *Allergy.* Any mycotic infection which itches severely shows an eczematous reaction in the skin which indicates sensitization to the fungus. Sensitization to staphylococcus is a factor of probable importance. Sensitization to shoe polish and to antiseptics and fungicides causes type of dermatitis frequently mistaken for mycotic infection.

4. *Hyperidrosis.* Excessive sweating induces maceration and desquamation of the skin and makes it susceptible to bacterial invasion which is apparently nonspecific. This is responsible for many painful and persistent cases of dermatitis of the feet. The causes of hyperidrosis are often obscure and probably multiple. Foot strain or bad hygiene can be recognized as responsible in some cases.

5. *Trauma.* Excoriation by fingernails or violent rubbing with a towel is responsible for much damage to toes and their webs. Friction from sand

or other foreign bodies in the shoe is sometimes a factor. It is interesting, however, that friction blisters are rarely the starting point of a dermatitis.

6. *Hypostasis.* The localization of these lesions to the feet is probably due in part to high venous pressure. The long periods of standing imposed on many troops is probably an etiological factor in foot dermatitis.

Trauma and hypostasis, however, seem only contributing factors and cannot be considered the sole cause of cases of dermatitis.

GENERAL PRINCIPLES

Successful treatment of dermatitis of the feet requires consideration of all these possibly etiological factors. Treatment must combat the causative factors involved and must also be adapted to the condition of the skin. For that reason, methods will be discussed under the type of case to which they are applicable. There are, however, two principles that must be followed in all cases:

1. *Hygienic measures are of first importance.*

a. Cleanliness by frequent and careful washing of the feet and frequent changing of socks.

b. Dryness by careful wiping especially between the toes after each bath, at the same time taking care not to injure the toe webs by violent rubbing.

c. Aeration by removing shoes and socks on every possible occasion.

d. Elevation of the feet by lying down during rest periods so as to relieve hypostatic congestion.

These measures seem obvious but require emphasis. Limitation of facilities and carelessness as to bathing, wearing heavy shoes during violent exercise in hot weather, and prolonged standing as well as marching are probably the factors which make dermatophytosis so prevalent among troops. Many cases will clear up without medication if the patients are allowed to rest with their shoes off.

2. *Treatment must avoid injury.* Emphasis on the infectious origin of dermatophytosis tempts many to use strong fungicides and antiseptics. When the first fails, a still stronger and more irritating one is often applied with the result that the patient suffers more from treatment than from his original infection. Complete sterilization of the skin or destruction of the last fungus spore may never be possible. Success in treatment probably depends on inhibiting the growth of fungi and bacteria until the skin can heal. This can usually be accomplished by relatively weak, nonirritating fungicides and antiseptics. Occasional chronic cases with involvement of the thick stratum corneum of the sole may require more energetic treatment. Successful fungistatic treatment requires frequent and regular application which can only be accomplished by issuing medication to the soldier for self treatment.

Treatment must vary with the etiology and type of involvement, but even among cases where these factors seem identical, some individuals will be intolerant of applications satisfactory to most. Alternative medications must be provided for such cases. New fungicides are under study which offer promise of more effective treatment, but good results can be obtained by the intelligent use of familiar treatment agents which are readily available.

DERMATOPHYTOSIS

Fungi have been found in about 70 percent of cases of intertrigo of the toes and in over 90 percent of dysidrotic lesions on the soles. The most effective treatment agents in such cases are those which attack the fungus. It has been impossible to sift thoroughly all the fungicides recommended, most of which doubtless have proved effective in some cases. In general, iodine, a number of mercurials, thymol, and several essential oils have seemed low in effectiveness and irritating in a significant number of cases. The dyes, too, appear weakly fungicidal. Of the familiar fungicides, benzoic acid, salicylic acid, and sulfur appear the most useful if properly prepared.

The vehicle used in the application of these fungicides is important. Aqueous solutions lack in penetration. Solutions in alcohol, acetone, or chloroform appear more effective but dry the skin and promote fissuring on continuous use. Ointments, especially petrolatum, often macerate the skin. The addition of a powder to an ointment as in Lassar's paste lessens this effect, but for soldiers on active foot duty ointments should be used only at night and wiped off very thoroughly in the morning and a powder applied to the toes. The G.I. foot powder or plain talc is satisfactory for this purpose. The addition of 10 to 25 percent bentonite to talc powder increases its absorptive quality. Various types of dermatophytosis require separate consideration:

FIGURE 1. Eczematous dermatitis from shoe polish.

1. *Simple intertrigo.* Most cases of dermatophytosis begin with involvement of the sides and webs of the toes. Such lesions may cause intense itching though they often persist for years without attracting attention. Even if asymptomatic, they require treatment because they form the starting point of more troublesome types of dermatophytosis. Attempt should be made to differentiate them from the purely pyogenic or hyperidrotic lesions described below, and the fact that lesions of syphilis, psoriasis, and other generalized dermatoses may occur between the toes must be borne in mind.

An ointment or paint should be applied to the sides and webs of all the toes and to the entire sole of the foot every night

until the skin appears normal. To prevent relapse, the same treatment should be applied once a week throughout the warm season. An effective fungistatic paint which is not drying is [No. 1] *Benzoic Acid Paint,* the formula for which is benzoic acid 5 gm., acetone 15 cc., cottonseed oil 85 cc. Salicylic acid and merthiolate paint [No. 12], or iodine, salicylic, and benzoic paint [No. 11] may be used if a more drying effect is desired

For obstinate cases ointments are often more effective. One of the best is [No. 2] *Sulfur and Salicylic Ointment,*[1] the formula of which is salicylic acid 10 gm., sulfur ppt. 10 gm., starch powder 30 gm., petrolatum 50 gm. *Whitfield's Ointment* (one-half strength) [No. 3] made on the following formula is also effective: salicylic acid 3 gm., benzoic acid 6 gm., benzoinated lard 31 gm., Lassar's paste 60 gm. Full-strength Whitfield's ointment should never be used except in chronic and obstinate cases. Either of the above-named ointments must be wiped off and replaced by powder before exercise and even so may produce some maceration if used on active duty in very hot weather.

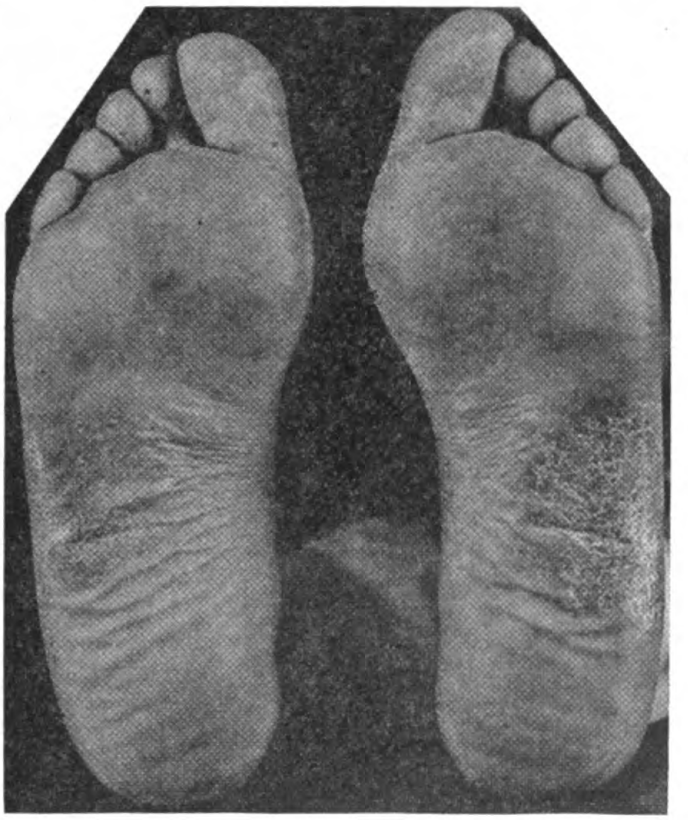


FIGURE 2. Pustular bacterid (not a local infection). This chronic eruption healed after removal of tonsils and treatment of paranasal sinuses.

In field dispensaries if supplies for issue to troops are not available, a slight alteration of formula No. 1 renders a single application more effective, though this paint is too drying for daily use. The formula for [No. 4] *Benzoic Acid Paint,* for application in dispensary, is benzoic acid 5 gm., acetone 85 cc., cottonseed oil 10 cc.

2. *Fissured and denuded cases.* The most frequent cause of pain in dermatophytosis is fissuring of the skin on the webs or

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The numerals in brackets are for convenience in referring to the various formulas.

1. Taylor, S. J., Jr.: Simple Treatment for Epidermatophytosis, Mil. Surgeon, 91:93-96, July 1942.

bulbs of the toes where it has been weakened by persistent dermatitis. Excoriation by fingernails or the rupture of large vesicles may also produce painful areas denuded of their protective stratum corneum. These developments which expose the rete govern the choice of treatment. Alcoholic or acetone solutions should never be applied, and agents such as salicylic or benzoic acids which cause exfoliation should be avoided.

All such cases benefit from care in the dispensary or clinic, and the severe ones require frequent dressings. Small fissures may be handled satisfactorily by painting with 5 percent aqueous silver nitrate. (This solution is best kept in small dark-glass bottles containing about 5 cc., as frequent dipping into the solution with a swab precipitates it.) For more severe lesions we have found the most useful dressing a gauze similar to ordinary vaseline gauze, but with some bacteriostatic agent added. A suitable formula, [No. 5] *Zephiran Ointment,* would be as follows: zephiran concentrate 10 percent 5 cc., water 20 cc., lanolin 25 cc., petrolatum 50 cc.

A pack of 20 to 100 layers of gauze cut in pieces 2 by 5 inches, or other convenient size, is placed in a small catheter tray, butter dish, or similar metal or glass box. The folded sterile gauze supplied for dressings is usually satisfactory. Bandage gauze is too stiff to mold well to the skin surface, and most gauze supplied in bolts is too flimsy. Melted zephiran ointment is poured over this, and the dish is heated to from 60° to 100° C. for one-half hour by placing on top of a water bath or in a drying oven. Sufficient ointment should be used so that the mesh of the gauze remains filled with it after cooling. Suitable pieces of gauze are cut off with scissors and laid over fissures and denuded areas. They are useful in dressing broken blisters and all types of small skin injuries. The ointment will cause them to adhere for a while, but they are better held on with a gauze pad secured by plaster or bandage, or by a band-aid type of dressing.

In some obstinate cases, 5 percent sulfathiazole ointment succeeds when zephiran ointment does not.

3. *Plantar lesions.* On the sole of the foot where the stratum corneum is thick, the vesicles of dermatophytosis do not rupture early but enlarge to form multilocular bullae often 5 and sometimes 10 mm. in diameter. Satellite vesicles appear around them and form a gradually extending group. They are filled with a characteristic clear, viscid fluid. On drying, they form desquamating areas and repeated desquamation may leave the skin thin and sensitive. This "dysidrotic" type of dermatophytosis may itch intensely, and areas denuded by rupture of the bullae make walking painful. Occasionally, however, large bullae are seen which cause no symptoms whatever. Invasion of the sole does not always cause vesiculation. Dry desquamating areas are seen, in which fungus can be demonstrated. The appearance of the vesicular lesions is so familiar and characteristic that diagnosis presents few difficulties. They must, however, be differentiated from the vesicular lesions of erythema multiforme, drug eruptions, and acute streptococcus dermatitis. Syphilis and psoriasis may simulate the scaling lesions of dermatophytosis.

The lesion most frequently mistaken for dermatophytosis is the pustular bacterid. Here the primary lesions are minute and frequently hemorrhagic pustules which appear in repeated showers on localized areas of the soles and palms. They occur characteristically at points of pressure. After repeated outbreaks, the involved area becomes covered with psoriasiform scales. The resulting appearance has given origin to the misleading designation of "pustular psoriasis" often applied to these lesions. They are, in fact, cutaneous reactions to a distant focus of infection such as a tonsil or a tooth socket, and local treatment has little effect on their course.

Dysidrotic dermatophytosis is often resistant to treatment. In mild cases the remedies used for simple intertrigo [Nos. 1, 2, 3, and 4] may be effective. In acute cases or those which have been overtreated or where rupture of vesicles has caused extensive denudation, the usual fungicides cannot be used. Foot soaks for ten to thirty minutes are most effective in reducing the inflammation. Of these the best is [No. 6] *Potassium Permanganate Bath* (about 1:4000), the formula for which is potassium permanganate 15 grains, tap water 1 gallon.

Boric acid 4 percent, magnesium sulfate 25 percent (2 pounds in one gallon of water), or aluminum acetate solution prepared by dissolving one Burow's solution tablet, Domeboro, in 16 ounces of water. Double this strength may be used. Zephiran is one of the best foot soaks as it is an active fungicide and antiseptic. Twenty cc. of 10 percent zephiran concentrate in two liters of water make a nonirritating bath. Other baths that are often useful are acriflavine 1:3000 in normal saline, and azochloramid 1:3000 prepared by dissolving 10 gm. of the stock azochloramid saline mixture in 1 liter of water. If the patient is ambulant, the foot should be dressed after soaking. If hospitalized, they often do best dried and exposed to the air. Zephiran gauze [No. 5] or boric acid ointment covered with a pad of dry gauze makes the best dressings.

FIGURE 3. Dysidrotic dermatophytosis. Note characteristic collarettes from ruptured vesicles on heel.

In chronic cases of dysidrotic dermatophytosis where the horny layer is intact, quite different procedures are needed. Parasites embedded in the thick stratum corneum are well protected from fungicides applied to the surface. It is often necessary to peel off the infected horny layer by applications too

irritating to be used in the ordinary case. If the reaction is severe, one must resume the foot baths used for acute cases. The following measures should not be used for men on active foot duty or applied to the thin skin on the dorsum of the foot: [No. 7] *Salicylic Acid Paste* containing salicylic acid (powdered) 20 gm., cottonseed oil 20 cc., Lassar's zinc paste 60 gm. This paste may be bandaged over the affected area daily for three to five days. When the skin turns white, it is allowed to dry and to peel. After a week, the ointment may be reapplied. Full-strength Whitfield's ointment is permissible. Other alternative procedures are daily painting with eugenol or [No. 8] *Chrysarobin Paint* (chrysarobin 2 gm., cottonseed oil 10 cc., chloroform 90 cc.). After a few successive peeling treatments, milder fungicides such as benzoic acid should again be used.

4. *Lesions on dorsum of foot.* Invasion by the fungus of the thinner skin on the dorsum of the foot rarely causes distinct vesicles. It usually causes slightly reddened scaling areas which may form distinct rings or may be diffuse. Mycelium is readily demonstrated in the scales. These desquamative lesions on the dorsum respond well to preparations such as No. 1 or to any simple fungicide.

A more frequent occurrence on the dorsum is the eczematous dermatophytid. Dermatophytosis of the feet may cause vesicular or eczematous eruptions on the hands or elsewhere in which no fungus can be demonstrated. These are probably caused by an allergic reaction to fungus spores or antigens transmitted from the focus on the foot through the blood stream. Eczematous lesions which appear on the feet contiguous with, or slightly removed from, a focus of mycotic infection are probably similar reactions to antigens absorbed by the lymphatics or spread over the surface. This type of reaction is frequent on the dorsum of the toes. As in the case of other dermatophytids, fungi cannot be demonstrated in these lesions. Often the only proof of their etiology is their disappearance when the responsible focus on the toes, sole, or nail is cleared.

It is not always possible to draw a sharp line between these two types of lesion. Gradations seem to occur between scaling lesions with little inflammatory reaction in which the fungus is abundant, and swollen, red, weeping patches in which no fungus can be found. It is possible that an allergic dermatitis may develop in an area of actual fungus infection. As the allergic reaction increases, the fungus is more and more effectively destroyed. The practical point is that when lesions show the swelling, redness, and fine vesiculation characteristic of eczema, they should not be treated with fungicides but with soothing applications, at least until the inflammatory reaction subsides. The area may be painted with aqueous gentian violet and then spread with Lassar's zinc paste and covered with a gauze dressing. The formula for [No. 9] *Aqueous Gentian Violet* is gentian violet 2 gm., zephiran concentrate 10 percent 1 cc., alcohol 5 cc.,

water 90 cc. Wet compresses of boric acid or of Thiersch's solution are helpful. The formula for [No. 10] *Thiersch's Solution with Menthol* is menthol 0.2 gm., salicylic acid 0.25 gm., alcohol 95 percent 10 cc., boric acid 2.00 gm., water q.s. ad. 100 cc. (This same solution is useful as an antipruritic lotion patted on lesions. If they are not exuding, it may be strengthened by increasing the menthol to 0.5 gm. and the alcohol to 50 cc.) At the same time, any focus of fungus growth on the toes or soles, or a pyogenic paronychia, from which antigen may be absorbed, should be actively treated.

5. *Follow-up treatment.* After an active dermatophytosis has subsided, the importance of follow-up treatment should be impressed on the patient. Hygienic measures (page 43) should be stressed, and the patient should be given a fungicidal paint with instructions to paint the entire surfaces of the toes, the toe nails, and the entire soles of the feet once a week. Formulas No. 1 and No. 12 or iodine, salicylic, and benzoic (ISB) paint are satisfactory. The formula for [No. 11] *ISB Paint* is Tr. iodine (7 percent) 15 cc., salicylic acid 3 gm., benzoic acid 6 gm., camphor 10 gm., alcohol q.s. ad. 100 cc.*

FIGURE 4. Dermatophytid of toe. Fungus not present on dorsum of toe but growing in interdigital cleft.

6. *Onychomycosis.* Invasion of the nails by fungi rarely causes symptoms but is probably the most frequent source of reinfection of the feet. The commonest lesion, a chalk-like spot which appears often where the bulb of the next toe overlies the nail, is not difficult to eradicate. Deep invasion which undermines the nail, causes it to thicken, and ultimately erodes the nail plate is seldom affected by the simple application of fungicides to the surface. Removal of the nail entails too long disability to be practical except in rare cases and even this radical procedure often fails. There remain two possible procedures:

1. Repeated thorough removal of all portions of the nail that have become friable or loosened from the bed, followed by application of a fungicide. This requires the use of clippers, file, and curette, and as much care as a dentist employs in cleaning a tooth cavity. The patient can rarely make a thorough job of it, but a noncommissioned officer can be trained in this procedure.

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*Frazer's Solution (Med. Dept. Item No. 91098) is of practically identical composition.

2. Abandoning any attempt at cure, but applying a fungicide once or twice a week to the nail with the aim of preventing spread. For this purpose, tincture of iodine, chrysarobin paint [No. 8] or ISB paint [No. 11] may be used.

7. *Ringworm of the groin and trunk.* The same fungi found in dermatophytosis of the feet cause the marginate dermatitis of the groin which is prevalent among troops in hot weather. Circinate lesions often extend widely over the trunk especially around the waist where the belt presses. The same fungicides may be used as in the treatment of intertrigo of the feet, but both groin and trunk lesions are much more easily irritated than those on the thicker skin of the feet, and, on account of the accumulation of sweat in the groin, ointments are rarely tolerated there. Benzoic acid paint [No. 1] can usually be used without irritation. A very satisfactory paint for lesions that are not eczematized is [No. 12] *Salicylic Acid and Merthiolate Paint,*[2] the formula of which is salicylic acid 3 gm., Tr. merthiolate (1:1000) 100 cc. For the groin, the fungicide should be painted on at night and plain talc or G.I. foot powder applied liberally in the morning.

If the above preparations irritate, the lesions may be painted with gentian violet or 10 percent argyrol until they become less sensitive. The use of concentrated iodine, salicylic acid, or mercurial preparations seems unwise; while often successful, they sometimes cause a dermatitis much worse than the original disease.

PYOGENIC LESIONS

Superficial staphylococcic lesions are extremely prevalent among troops in hot weather. They follow insect bites and scratches and often appear without detectable cause. They often occur on the dorsum of the foot. Between the toes they simulate mycotic intertrigo so closely that they are hard to differentiate without microscopic examination. It seems well whenever a case of supposed dermatophytosis shows marked redness, exudation, or crusting, to treat it first with zephiran ointment [No. 5] or gentian violet paint [No. 9] before proceeding to fungicidal measures. A freshly prepared paste of about 2 parts zinc peroxide and 3 parts lubricating jelly (Med. Dept. Item No. 12452) is often useful for pyogenic lesions. The zinc peroxide should be activated by heating at 140° C. for four hours in a hot-air sterilizer. Wet dressings with acriflavine 1:1000 in normal saline are sometimes effective in refractory cases.

The sulfonamides are the most effective agents for impetigo and other superficial pyogenic lesions. Objection is raised as to their routine use on account of the possibility of sensitizing patients. They will however be found useful and promptly effective in many lesions that resist all other measures. For most cases 5 percent sulfathiazole in any convenient ointment base may be used. For exuding lesions the following paste is

2. Major James S. Snow, personal communication.

especially useful if spread on in a thin film so that it will not cake: [No. 13] *Sulfathiazole in Bentonite Paste,* the formula for which is sulfathiazole 5 gm., cottonseed oil 10 cc., bentonite 10 gm., water 90 cc. Soak the bentonite in water until a gelatinous paste is formed and then rub in the other ingredients.

The management of abscess, cellulitis and lymphangitis, the most serious sequelae of dermatophytosis, hardly comes within the scope of this paper. Such cases should be treated in the hospital. The infection is beyond the influence of local applications but responds well to sulfonamides internally. After recovery, the foot lesion which formed the portal of entry should be carefully and thoroughly treated to prevent a recurrence of the deep infection.

ALLERGIC DERMATITIS

Dermatitis from contact with sensitizing chemicals is indistinguishable morphologically from allergic reaction to fungi. Contact dermatitis rarely occurs on the sole. When such lesions occur on the feet, one must suspect first the medication previously applied as this is the most frequent cause. Polish or other chemicals in shoe leather is the next most frequent cause. Internal medications, especially the sulfonamides, may produce a similar dermatitis but it is rarely restricted to the feet. Allergy to food and inhaled substances is rarely or never a factor in these cases.

Identification of the responsible allergen requires thorough study, including the use of patch tests which is often impracticable under military conditions. Some clue may be obtained from the distribution of the lesions. Eczematous patches extending back from the interdigital clefts and occurring on the dorsum of the foot and ankle in rounded patches are frequently due to fungus. Those extending back from the base of the toenail are frequently due to pyogenic paronychia. Diffuse reactions on the dorsum of the foot, stopping sharply at the line of the shoe vamp or at the top of the shoe, are frequently due to shoe polish.

Symptomatic treatment consists in soothing and antipruritic applications. As the lesions are usually infected with staphylococci, a mild antiseptic, such as gentian violet, is often necessary. The measures described under "Lesions on Dorsum of Foot" are useful, especially the occlusive dressing with aqueous gentian violet [No. 9] and Lassar's zinc paste which protects the lesions if the exciting allergen is external.

HYPERIDROSIS

In about 30 percent of the intertrigo cases seen at sick call during this study, we have been unable to demonstrate fungus although examinations have sometimes been repeated for eight to ten weeks. Some of these cases are probably dermatophytosis in which microscopic examination has failed, some are pyogenic infections; but the majority seem due primarily to excessive sweating. Accurate differentiation from mycotic intertrigo requires microscopic examination, but the following characteristics point to hyperidrosis as the cause:

1. Other evidence of profuse sweating of feet and hands, especially the characteristic local hyperidrosis of the soles. 2. Flat feet or other evidence of foot strain. 3. Cyanosis or other evidence of peripheral vascular disorder. 4. Edema of the toes. 5. Equal involvement of all interdigital spaces. 6. Excessive maceration with exceedingly foul odor. 7. Absence of vesicles or the collarettes which indicate ruptured vesicles. 8. Pain, usually described as "burning," rather than itching.

Local hyperidrosis. Hyperidrosis of the sole frequently causes a curious and typical lesion rarely seen in civilian life. It is probably the same condition described as "symmetrical lividity of the soles." The lesions are white plaques surrounded by pink or lilac halos, often on the bottom and sides of the heels, along the lateral border of the sole, or sometimes on the bulbs of the toes, especially where they rub together. Occasionally they are seen on the ball of the foot. In some cases they appear only after marching and disappear after rest; in others they are continuously present. The skin of these areas is often seen to be studded with little beads of moisture when the rest of the foot is dry. The surface of these areas is relatively alkaline. Measurements on ten cases gave an average pH of 6.7 (maximum 7.5, minimum 6.1) as against an average of pH 6.0 (maximum 6.3, minimum 5.65) for eight normal feet. Higher readings are obtained from the more distinctly macerated areas between toes. This suggests that the beads of fluid which appear on the surface may be interstitial fluid and not sweat. The patches are however apparently due to friction over an area macerated by sweat. The men often refer to them as "scalds," and they may be as tender as first degree burns. In our experience here, hyperidrotic intertrigo and localized hyperidrosis of the soles are more frequent causes of pain in marching and partial disability than is dermatophytosis. Hyperidrosis is frequently associated with flat feet and foot strain seems to be one etiological factor. Many of these patients perspire excessively also on the hands and their sweating is probably neuro- or psychogenic. Some show intense congestion of the feet, and in such cases the hyperidrosis may be secondary to peripheral vascular disease.

None of these causes are easy to control even if detected. Symptomatic treatment adjusted to the severity of the case will often give relief though it rarely results in permanent cure. Formalin, tannic acid, and alum are the most effective agents. An antiseptic is usually necessary to combat the secondary bacterial infection. In acute exacerbations, the greatest relief is obtained by a foot bath of 1 to 5 percent potassium alum (1 to 6 oz. per gallon of water). Four percent formaldehyde (10 cc. of the stock 38 percent solution to 90 cc. of water) painted on the skin one to three times daily usually stops the sweating for a while. Formalin cannot be used if there is marked fissuring or denudation. In other cases we have seen no irritation, but the possibility of formaldehyde sensitization must be borne in mind. Formaldehyde painting should rarely be continued daily for more than a week or two. It may be followed by [No. 14] *Tannic Acid*

Paint, the formula for which is tannic acid 10 gm., castor oil 10 cc., alcohol 95 percent 90 cc. If this is not effective the formalin painting should be continued once or twice a week. An astringent foot powder should be applied daily: [No. 15]*Alum Foot Powder* the formula for which is potassium alum exsiccated 25 gm., zinc peroxide (heat activated—see page 50) 25 gm., bentonite 25 gm., talc powder 25 gm. If the alum is not available, it may be replaced by 10 gm. of tannic acid and the talc increased to 40 gm. If the feet are too sore to tolerate formalin or even alum powder, dressings of tannic acid ointment U.S.P. should be applied following the alum bath. The addition of 5 percent sulfathiazole to this ointment makes it more effective.

PROPHYLAXIS

Rational procedures for prevention of dermatophytosis are difficult to devise on account of uncertainty as to its origin. Does a fresh outbreak mean a new infection or a recrudescence of a latent infection? There is grave doubt whether exogenous infection is a factor of importance. Inspection of troops shows lesions of probable dermatophytosis in 80 percent or more. Microscopic examination reveals fungus on the feet of 30 percent to 50 percent and considering the fallibility of such examinations, the percent of actual infection is probably far greater. This high carrier rate diminishes the probability of success by any means aimed at preventing transfer of infection. If prevention of infection is impractical, the only promising prophylactic procedure is the prevention of activation. By this we mean the treatment of incipient and latent cases before they become troublesome. This can be carried out within the framework of present army routine. At monthly inspection, men should stand with their backs to the medical officer and raise each foot so as to expose the sole and the toe webs. Every man showing evidence of dermatophytosis should be given preparations for self treatment, such as benzoic acid paint [No. 1], salicylic acid and merthiolate paint [No. 12], and the ISB paint [No. 11]. He should be required to report for reinspection until he has cleared his feet, and should then be instructed to treat his feet every week throughout the warm season in order to prevent relapse.

The possibility that infection from floors, baths, or laundry, and reinfection from shoes and socks are important factors has never been excluded. Among recruits especially, disinfection of floors and showers, protection of feet by wearing wooden sandals, and the application of a fungicide such as benzoic acid paint [No. 1], salicylic acid and merthiolate paint [No. 12], and ISB paint [No. 11] after bathing are measures well worth trial. At present, their value is unproved and no reliance can be placed on them. The evidence favors the view that the patient's own feet are the source of the infection which flares up under stress of hot weather, heavy shoes, and violent exercise. Hygienic care of the feet and treatment of incipient and latent infections are the only prophylactic measures that offer great hope of success.

The Discovery of Penicillin

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I have been asked to say how I came to discover penicillin. After a lapse of fifteen years it is very difficult to say just what processes of thought were involved, but it seems necessary to go back much further than 1928 when the activity of penicillin was first observed.

ANTECEDENT INVESTIGATIONS

As one of the pupils of Sir Almroth Wright I had naturally been deeply interested during the whole of my career in the destruction of bacteria by leucocytes. During the 1914-18 war I spent much time investigating problems in connexion with septic wounds, and I was then impressed with the antibacterial power of the leucocytes contained in pus which exuded from septic wounds. It was also clear from these investigations that the chemical antiseptics in common use were more destructive on the leucocytes than they were on bacteria.

This interest in antiseptics and leucocytes was continued in post-war years, and in 1924 I was able, by a simple method, to demonstrate clearly the antileucocytic power of antiseptics, and to indicate that if the antileucocytic action of an antiseptic were greater than its antibacterial action, such antiseptic was unlikely to be successful in the treatment of a septic wound.

In 1922 I described lysozyme, a powerful antibacterial ferment occurring naturally in human tissues and secretions, in the white of the domestic hen's egg, and elsewhere.

EFFECT OF CONTAMINATION OF A CULTURE

In September 1928 I was working on the variation of staphylococcus colonies following on a publication by Professor Bigger, who had shown that colonies of widely different appearance could be produced from a pure culture of an ordinary pyogenic staphylococcus. In the course of these observations culture plates of staphylococci were examined at intervals with a dissecting microscope, which involved a temporary removal of the cover and exposure to contamination from the air. After examination, some of the culture plates were placed in the incubator and others were left to mature at room temperature. Further examination

This article on penicillin and the two following are reprinted from the British Medical Bulletin No. 1, Vol. 2, 1944.

of one of the latter showed that a mould colony had developed toward one side of the culture plate. Such contamination with a mould was, in the circumstances, not unexpected, but what was astonishing was that in this particular culture plate the staphylococcal colonies for some considerable distance round the mould growth were obviously undergoing lysis. What had originally been a well-grown staphylococcal colony was now a faint shadow of its former self.

It is certain that every bacteriologist has not once but many times had culture plates contaminated with moulds. It is also probable that some bacteriologists have noticed similar changes to those noted above, but that, in the absence of any special interest in naturally occurring antibacterial substances, the cultures have simply been discarded.

It was, however, fortunate that, with the background I have briefly sketched, I was always on the lookout for new bacterial inhibitors, and when I noticed on a culture plate that the staphylococcal colonies in the neighbourhood of a mould had faded away I was sufficiently interested in the antibacterial substance produced by the mould to pursue the subject.

EXPERIMENTAL OBSERVATIONS

The next step was to touch the mould colony with a platinum wire and transfer some spores to a culture tube of Sabouraud's medium which, to the ordinary bacteriologist, is the usual medium for growing moulds. It is interesting that until recently all the penicillin used clinically had been produced from sub-cultures of this original tube. This first pure culture of the mould has not survived the years, but the original culture plate with the mould colony inducing dissolution of staphylococcal colonies still exists (see figure 1). The preservation of this culture shows that, although I was unable to concentrate the antiseptic substance sufficiently for therapeutic use, I yet considered the culture a memorable one.

Having got a pure culture, I grew it in the ordinary nutrient broth used by bacteriologists. It grew as a felted mass on the surface. After a week it was found that the culture fluid diluted some 500 to 800 times would completely inhibit growth of staphylococci, and it was therefore some two or three times as strong in that respect as pure carbolic acid. It was obvious from this that the antibacterial substance produced by the mould was a remarkable one and demanded further investigation.

The mould belonged to the genus *Penicillium*, so that the active substance, which was then (and still is at the time of writing) of unknown chemical constitution, was christened "penicillin." The mould was later identified as *Penicillium notatum*, a species which had been found by Westling in decaying hyssop in Norway (Thom).

From the appearance of the original plate it was obvious that penicillin was readily diffusible in agar, just as was lysozyme, which I had investigated some six years earlier. The technique which we had used with lysozyme was applicable to penicillin. One method used and figured in my original paper was to cut out a strip of agar from a culture plate, plant various bacteria in streaks at right angles to the gutter thus formed, and then fill the gutter with agar mixed with penicillin. The active substance diffused into the agar and inhibited the different bacteria for a distance varying with their sensitivity to penicillin. Some, such as *B. coli* or *H. influ-*

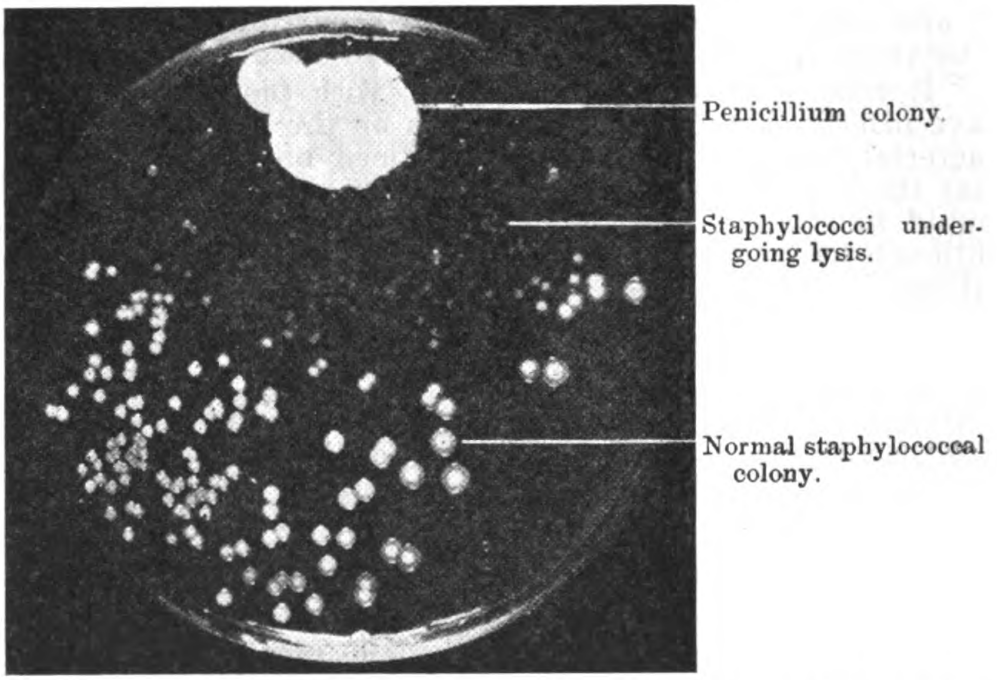

FIGURE 1. This photograph shows the original contaminated culture which led to the discovery of penicillin. The patch at the top is the growth of mould (*Penicillium notatum*). In the lower third, normal staphylococcal colonies are seen. For some distance around the mould, the growth of staphylococci has been suppressed.

Until recently, all penicillin produced in Britain and the U. S. A. was derived from sub-cultures of the mould colony shown in this photograph (which is reproduced from Fleming's 1929 paper in the *British Journal of Experimental Pathology*).

enzae, were not inhibited at all, while other, such as *Staphylococcus, Streptococcus, Pneumococcus, Gonococcus,* and the diphtheria bacillus would not grow anywhere near the penicillin strip (see figure 2). It was therefore clear that penicillin had a specific action on some bacteria and did not affect others, and it is interesting that the bacteria originally found to be sensitive in this way to the crude culture fluid are the same as those which have subsequently been found to be affected by concentrated penicillin used clinically.

In view of the results I had previously obtained with the chemical antiseptics in common use, I proceeded to test whether, like these, penicillin was poisonous to human leucocytes. It had no poisonous effect, nor was it toxic when injected into animals.

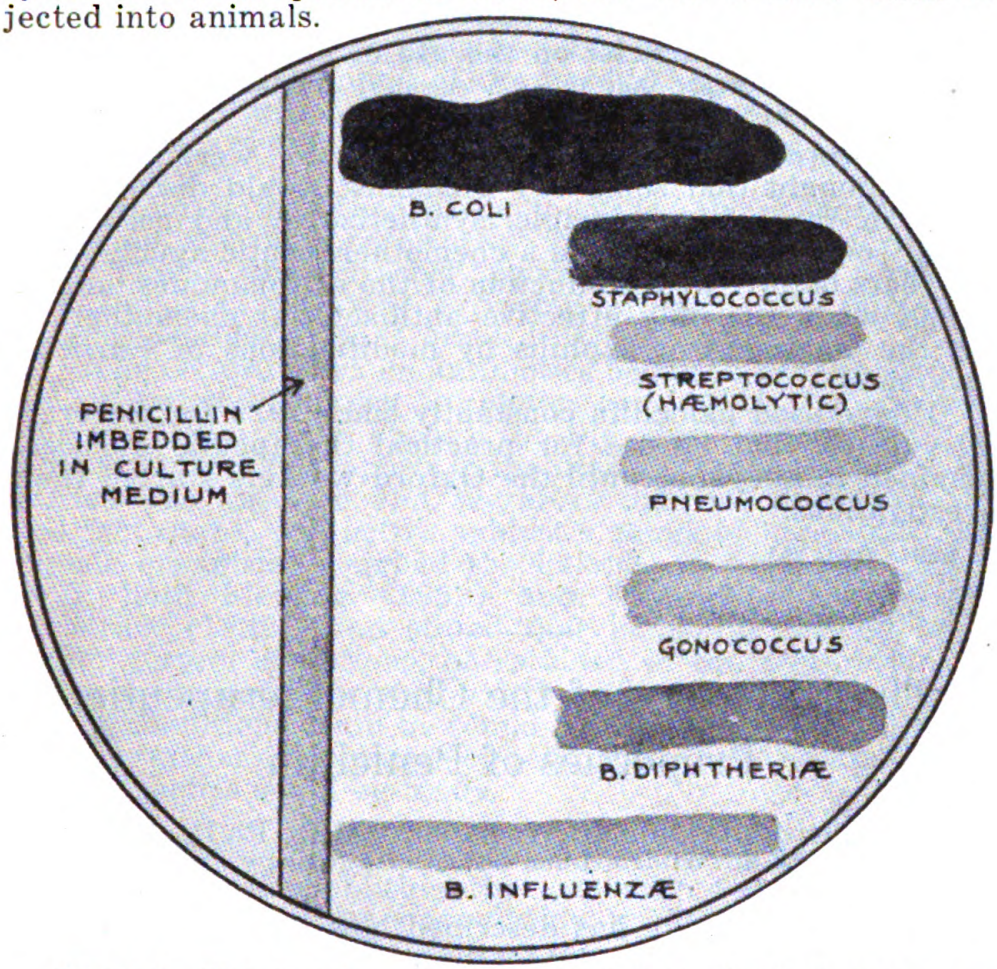

FIGURE 2. This drawing, also reproduced from Fleming's 1929 paper, shows the differential bacteriostatic effect of a penicillin-containing fluid in a gutter made by cutting out a strip from the agar medium. Inocula of various bacteria have been made at right angles to the gutter. Growth of *B. coli* and *H. influenzae* is not inhibited at all, while growth of the other organisms is inhibited in varying degrees.

CONCLUSIONS

Here, then, we had an antiseptic substance which at that time was unique in having a strong inhibitory effect on many of the common bacteria which infect the human body, but which was not toxic to animals or to human leucocytes. Unfortunately it was a very unstable substance, and early attempts to concentrate it had little success. Although some tentative observations on the local antiseptic action of the crude fluid were made with moderate success, its instability and the smaller number of septic cases in hospital in peace time led to its clinical use not being seriously pursued.

The laboratory results, however, together with the few clinical observations, made me state in the summary of my original paper[1] in 1929 that:

> It may be an efficient antiseptic for application to, or injection into, areas infected with penicillin-sensitive microbes;

and in 1931 in an article[2] on the use of antiseptics:

> It is quite likely that it, or a chemical of a similar nature, will be used in the treatment of septic wounds.

The words "chemical of a similar nature" were prompted by the thought that some day a chemist would discover the nature of the active principle, synthetize it, and use either that or some modification as a chemotherapeutic agent. That was years before the introduction of the sulfonamides, and at a time when the only effective antibacterial chemotherapy was the treatment of syphilis by modifications of Ehrlich's salvarsan.

I have used penicillin constantly since 1929 for differential culture,[3] but its use for practical therapeutic purposes remained in abeyance until the Oxford workers started their investigations.[4]

1. See BMB 203.
2. See BMB 241.
3. Described in BMB 200.
4. Described in BMB 199.

The Discovery of the Chemotherapeutic Properties of Penicillin

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Professor Fleming has described how he discovered that the mould *Penicillium notatum* produces a substance which inhibits the growth of certain pathogenic bacteria and the experiments which he performed with this substance. In this article we propose to trace the steps which led to the discovery of the chemotherapeutic properties of penicillin and eventually to its employment in treating diseases in man.

PLANNED INVESTIGATION OF ANTIBIOTICS

It may be of interest to know why the work was taken up in Oxford. In 1929 one of us (H. W. F.) started work on an antibacterial substance, lysozyme, which had been discovered by Fleming in 1922. During the 1930's this work was carried on till the enzyme was purified by Roberts (1937) and its substrate was characterised (Epstein and Chain, 1940). During the later part of this work the present writers prepared a plan for the systematic investigation of antibacterial substances produced by micro-organisms. It was thought that

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these might be chemically and biologically interesting, especially as many of them were active against pathogenic bacteria.

As long ago as 1877, Pasteur and Joubert noticed that the growth of certain air-borne organisms inhibited the growth of the anthrax bacillus, and suggested that this fact might be of importance in therapeutics. Since that time, many instances have been found of the production of a substance by one microbe which inhibits the growth of others. These inhibitions are due to metabolic products, recently termed "antibiotics."

Attempts had been made to utilise these substances in medicine, the most noteworthy being that of Emmerich and Loew (1899) who extracted "pyocyanase" from *Ps. pyocyanea*, and Dubos (1939) who extracted gramicidin, a mixture of two polypeptides, from *B. brevis*.

The Oxford work on antibiotics began to develop in 1938. Of a number of known antibiotics considered, "pyocyanase" and penicillin were chosen for the first investigations. It appeared from the reports in the literature that the latter substance was unstable and therefore difficult to extract, but the fact that it was active against a range of important pathogenic organisms weighed the balance in its favour. Moreover, both Fleming (1932) and Clutterbuck, Lovell and Raistrick (1932), had stated that penicillin activity might, under certain conditions, be retained in the culture medium for some weeks. It seemed worth while to see whether appropriate conditions could be found for extracting the substance, so that further examination of both its biochemical and biological properties could be made.

PHYSICAL AND CHEMICAL PROPERTIES OF PENICILLIN

It was first established that penicillin was an acid which, as the free acid in aqueous solution, was very unstable, but in the form of alkali and alkaline earth salts was stable between *p*H 5 and *p*H 7. Clutterbuck *et al.* had found that penicillin was extracted into ether on shaking with the culture fluid after it had been acidified. When the ether was evaporated, however, the activity was largely lost. This experiment was confirmed, but it was found possible to prepare stable salts of penicillin by shaking the ether solution with dilute aqueous alkali so as to bring the final *p*H to 7. In addition to ether, a number of organic solvents, for example chloroform and amyl acetate, could be used to extract the free acid form of penicillin. The salts of penicillin were much more soluble in water than in the organic solvents, and therefore penicillin was removed from the organic solvent by about 1/5 to 1/10 the volume of alkali solution. A concentration of penicillin was thereby achieved, and by repeating the extraction several times with different solvents and at suitable *p*H, a considerable purification of penicillin and simultaneous reduction of the bulk of liquid was obtained.

The losses of penicillin during these operations were small if the solutions were kept cold throughout. On drying the final aqueous solution *in vacuo* from the frozen state, a preparation of a salt of penicillin was obtained, in powder form, which kept its antibacterial activity unchanged for a long time.

METHODS OF PURIFICATION

Chemically, however, the preparation was far from pure, containing as is now known, not more than a small percentage of pure penicillin. The isolation of penicillin in the pure state from this mixture proved a difficult problem because of its instability towards many reagents and the unfavourable solubilities of the free acid and its salts. It was found that penicillin was destroyed by dilute acid and alkali, by many heavy metals (in particular zinc, cadmium, copper and mercury), and by primary alcohols, ketonic reagents and oxidising agents. The stable alkali and alkaline earth salts of penicillin were extremely easily soluble in water, and no organic cation forming a relatively insoluble salt with penicillin suitable for purification purposes was found.

The selection for the methods of purification of penicillin was therefore limited to distribution between different solvents and water, and to adsorption methods. Chromatographic methods have been used extensively. In combination with a reduction process with aluminum-amalgam it has been possible by these methods to produce penicillin preparations from which crystalline salts could be made. The purest material obtained at Oxford has an activity of about 1,000 Oxford units per mg., and is capable of inhibiting the growth of certain bacteria at a dilution of about 1:50,000,000.

BACTERIOSTATIC PROPERTIES, PHARMACOLOGY, CHEMOTHERAPEUTIC ACTION IN ANIMALS

Once a protein-free preparation containing a stable salt of penicillin was obtained it became possible to examine in detail its biological properties.

For the first biological experiments very crude preparations were used. Their antibacterial properties proved to be the same as those found by Fleming, who used crude penicillin-containing culture fluid. It was noted in addition that *Actinomyces bovis* and the group of anaerobic organisms causing gas gangrene were sensitive, but unfortunately not the tubercle bacillus.

So great was the antibacterial power of even the crudest extracts that at that time—not realising the extraordinary potency of penicillin—we believed them to be fairly pure. In actual fact we know now that they contained about 1 percent of pure penicillin. However, on the assumption that they were fairly pure, certain biological investigations were undertaken.

It was shown that the extracts were remarkably non-toxic to mice—a 20 g. mouse showed little or no disturbance after injection of 10 mg. of the sodium salt. It has since been found that 20 mg. of a much more highly purified extract can be given without any deleterious effects. Not only were the extracts relatively innocuous to the whole animal, but leucocytes and tissue cultures withstood many hundreds of times the concentration needed to inhibit such organisms as the streptococcus. In the light of present knowledge of the gross impurity of the original extracts, one can only be thankful that the mass of impurities, as well as the penicillin, were so little toxic.

Penicillin was readily absorbed in animals after intramuscular or subcutaneous injection, and from the small intestine. It could not of course be given by mouth because the acid of the gastric juice destroyed it, or by rectum as the bacteria present there inactivated it. It was largely excreted, still in an active form, in the urine of the mouse, rabbit and cat, and to a certain extent in the bile and saliva, though not in the tears or pancreatic juice of the cat. Though penicillin was readily soluble and diffusible, it did not pass in detectable quantities from the blood into the cerebro-spinal fluid.

In agreement with Fleming's observations it was found that the action of penicillin was bacteriostatic, in that it merely inhibited the growth of organisms and did not kill them quickly, as did poisonous antiseptics such as proflavine. The respiration of bacteria, as measured in a Warburg-Barcroft apparatus, was not affected by quite strong solutions, in contrast to most antiseptics which, acting on some protoplasmic constituent, rapidly cause the cessation of respiration. This bacteriostatic effect was reflected in the morphological changes undergone by sensitive bacteria when grown in a dilution of penicillin not sufficient to cause complete inhibition of growth. By interference with division, giant forms were produced.

Most antibacterial substances such as ordinary antiseptics and the sulphonamides are, for one reason or another, not active in the presence of pus, and hence their therapeutic efficacy is severely limited. It was therefore a particularly fortunate property of penicillin that pus, tissue autolysates, blood and serum had no inhibitory effect on its activity. It was found too that the number of organisms present had little effect on its inhibitory power—again a contrast with the sulphonamides.

In view of this combination of great antibacterial power with low toxicity, it was not altogether surprising that "mouse protection tests" gave a clear demonstration of the chemotherapeutic properties of penicillin. With appropriate dosage almost complete protection was afforded to batches of mice infected intraperitoneally with lethal doses of streptococci and staphylococci and intramuscularly with *Cl. septique.*

EARLY OBSERVATIONS ON HUMAN SUBJECTS

It will be seen from this account that a fairly complete knowledge of its properties, both chemical and biological, had been obtained before penicillin was used on man. In terms of the labour involved it was, however, a big step from experiments on mice to making observations on the human subject, for the mould produces very little of the active substance. Months elapsed before enough material could be accumulated to try the first injection on man.

Injection in the human subject disclosed that some substance was present in the crude penicillin preparations which caused a rigor and sharp rise in temperature. This had not been suspected from observations in animals. By good fortune the pyrogenic effect was due not to the penicillin but to an impurity which could be removed.

Insufficient material had been accumulated for the first 2 cases treated, and although both patients, who were seriously ill, did well for a time, they relapsed and further treatment could not be carried out for lack of material.

In the course of some months enough was accumulated (partly prepared in Oxford and partly in the laboratories of *Imperial Chemical Industries*) to treat by parenteral injection a further 18 patients. During the course of these observations it became clear that the behaviour of penicillin in man was no different from its behaviour in mice and cats. Toxic reactions, apart from the pyrogen, were not observed and some striking recoveries of patients infected with staphylococci were obtained. Suitable dosage was worked out and the principles of treatment were formulated. At the same time, penicillin was shown to be valuable for local application in various septic conditions.

INDUSTRIAL PRODUCTION AND CHEMISTRY

Considerable interest was aroused both in Britain and in the U. S. A. by the demonstration of the chemotherapeutic possibilities of penicillin in naturally occurring disease in man. All the main facts have now been amply confirmed and commercial firms and others are continually improving and developing methods of very large scale production by mould fermentation. One of the chief obstacles to be overcome in large-scale work is the destruction of penicillin which is brought about by the enzymes of many air bacteria. The most careful precautions against contamination are necessary at all stages of growth of the mould.

Immediately after the chemotherapeutic properties of penicillin were established, work on the elucidation of its chemical constitution was actively pursued at Oxford, in the *Sir William Dunn* School of Pathology by Dr. E. P. Abraham and one of us (E. C.) in collaboration with Dr. Wilson Baker and Sir Robert Robinson in the *Dyson Perrins* Laboratory. Subsequently many other chemists both in England and

America have started work on the penicillin problem. It is not possible at present to describe in detail the chemical work carried out, but it can be stated that it has led to the elucidation of the chemical constitution of the breakdown products of penicillin and has opened the way to eventual synthesis.

While no doubt large quantities of penicillin will be produced by culture of the mould, there is little prospect that sufficient for general use will be available for some time to come. It is probable that, if synthesis can be achieved, a new range of chemotherapeutic agents will be produced with properties varying in different ways from those of the original substance.

Now that it appears probable that penicillin will be used on a very large scale it is interesting to look back on the early days when we were many times assured that it was too unstable ever to be a practical proposition, and that in any case the vast amount of culture medium needed to produce small quantities of penicillin was an almost insuperable bar to its production.

We should like to emphasize that the work, covering as it did a wide field of investigation, could not have been carried through without the close collaboration of the various workers whose names appear on the papers concerned with penicillin which have come from this laboratory. The clinical work, too, was made possible only by the help and co-operation of many surgeons, physicians and bacteriologists.

REFERENCES

Clutterbuck, P. W., Lovell, R., and Ralstrick, H.: (1932) Biochem. J., 26, 1907. (See BMB 206.)
Dubos, R. J.: (1939) J. Exp. Med. 70, 1 and 11.
Emmerich, R., and Loew, O.: (1899) Z. Hyg. InfektKr., 31, 1.
Epstein, L. A., and Chain E.: (1940) Brit. J. Exp. Path., 21, 339.
Fleming, A.: (1932) J. Path. Bact., 35, 831. (See BMB 205.)
Pasteur, L., and Joubert, J. F.: (1877) C. R. Acad. Sci., 85, 101
Roberts, E. A. H.: (1937) Quart. J. Exp. Physiol., 27,89.

Peptic Ulcer and Dyspepsia in the British Army.—The high rate in the present war of admissions to hospital of British soldiers with peptic ulcer or nonorganic dyspepsia as compared with the first World War, Sir Henry Tidy states in the *British Medical Journal*, 16 October 1943, is a reflection of the increase in these conditions among the civilian population in the last twenty years. In 73 percent of cases of gastric ulcer, 82 percent of cases of duodenal ulcer, and 75 percent of cases of nonorganic dyspepsia, the onset had occurred in civilian life. Another factor is that in the Army a man is more likely to be admitted to hospital for minor symptoms than in civilian life. A soldier suffering from the transient dyspepsia that often occurs among recruits before they become accustomed to Army routine "should not be sent to hospitals or to specialists—procedures which are apt to convert a transient into a chronic dyspeptic, and finally into a useless soldier. Men suffering from nonorganic dyspepsia can in many cases make useful soldiers provided they are not detained too long in hospital. . . . An excess of medical attention and investigation results in exaggeration of symptoms and repeated admission to hospital."

Other Antibacterial Substances from Bacteria and Moulds

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The list below contains a selection of those antibacterial substances from bacteria and moulds which have been examined in some detail. A review of the early work on bacterial antagonism and antibiotics, up to 1941, has been published[29] and a review covering the more recent work is in the press.[4]

Species	*Antibiotic*	*Reference*
Antibiotics Produced by Bacteria		
Ps. pyocyanea	pyocyanine	16, 17, 26
"	*x*-oxy-phenazine	26
"	lytic agent	26
B. brevis	gramicidin	15, 10
"	tyrocidine	10
Antibiotics Produced by Actinomycetes		
A. antibioticus	actinomycin A.	31, 32
"	actinomycin B.	32
A. lavendulae	streptothricin	28, 33
Proactinomyces Gardner	proactinomycin	12
Antibiotics Produced by Penicillia		
P. notatum	penicillin	
P. claviforme, *P. patulum*	claviformin (also described as patulin)	2,5,6,9,37
P. puberulum, *P. cyclopium*	penicillic acid	1, 21
Antibiotics Produced by Penicillia		
P. (Gliocladium) fimbriatum	gliotoxin	11, 34, 35
P. citrinum	citrinin	25
Antibiotics Produced by Aspergilli		
A. flavus	aspergillic acid	18, 19, 36
"	flavicin	3
A. fumigatus	fumigacin	30
"	fumigatin	20
A. fumigatus mut. Helvola Yuill	helvolic acid	7, 37
A. clavatus	clavacin	30
A. giganteus	gigantic acid	22

From the British Medical Bulletin, No. 1, Vol. 2, 1944.

Two antibiotics produced by aspergilli, flavicin, and gigantic acid are very similar to penicillin in their chemical and biological properties. Thus it is evident that the production of penicillin-like substances is not confined to the species *Penicillium notatum* or even to the genus *Penicillium*.

All the other antibiotics, without exception, are less active against bacteria and more toxic to animal tissues than penicillin. With the exception of proactinomycin, helvolic acid and possibly streptothricin they are all protoplasmic poisons, exerting their antibacterial action by combining with a protoplasmic constituent common to all cells (proteins, lipids, etc.). However, the crude mixture of gramicidin and tyrocidine, designated as tyrothricin, has been used for the local treatment of infected wounds.[15 23 24] None of the other antibiotics has yet received such clinical trial.

Patulin, an antibiotic recently isolated from culture filtrates of *Penicillium patulum*[2] is identical with the previously described antibiotic claviformin.[6 9] Like all ordinary antiseptics this substance is a general protoplasmic poison and is toxic to mice and leucocytes. Patulin has been stated by one group of workers to be effective in combating the common cold,[2] but another group of workers has not been able to confirm this claim.[27]

The least toxic antibiotic, apart from penicillin, appears to be helvolic acid. This substance has many attractive properties from the chemotherapeutic point of view. It is very stable, and a bacteriostatic concentration can readily be maintained in the tissues. When it is given repeatedly, however, the liver suffers severe damage. When more facts about its chemical constitution become known it may be possible to reduce the toxic effect on the liver by modification of the molecule.

Though most of the antibiotics listed above have been obtained in the pure, crystalline state, the chemical constitution of many of them has not yet been elucidated. Several, e.g. gliotoxin (a sulphur-containing substance), proactinomycin (an alkaloid-like base), streptothricin and helvolic acid, as well as penicillin itself, are of chemical types hitherto unknown among antibacterial substances. The study of their structure provides many interesting problems and may lead to the synthesis of novel types of antiseptics and chemotherapeutic drugs.

Some antibiotics have in addition great biochemical interest. Thus gramicidin and tyrocidine belong to the very small group of crystalline polypeptides, and, as they are of relatively

low molecular weight, the complete elucidation of their constitution may be possible[13 14] with recently developed methods. This may throw some light on one of the most fundamental and difficult problems in biochemistry, the structure of proteins.

The antibacterial substance notatin[8] (also described as penicillin B or penatin), which is produced by *Penicillium notatum*, differs in nature from the antibiotics, being a glucose dehydrogenase which exerts its antibacterial action through the hydrogen peroxide which it forms. It has no action in the absence of glucose, nor in the presence of catalase, a constituent of all tissue cells. It is extremely toxic to animals and is unlikely to be of use in medicine.

REFERENCES

1. Alsberg, C. L., and Black, C. F.: (1913) U. S. Dep. Agric., Bur. Plant Ind., Bull. No. 270.
2. Birkinshaw, J. H., Bracken, A., Greenwood, M., Gye, W. E., Hopkins, W. A., Michael, S. E., and Raistrick, H.: (1943) Lancet, 2, 625.
3. Bush, M. T., and Goth, A.: (1943) J. Pharm. Exp. Therap. 78, 164.
4. Chain, E., and Florey, H. W.: (1944) Ann. Rep. Chem. Soc. in press.
5. Chain, E., Florey, H. W., and Jennings, M. A.: (1942) Brit. J. Exp. Path. 23, 202.
6. Chain, E., Florey, H. W., and Jennings, M. A.: (1944) Lancet, 1, 112.
7. Chain, E., Florey, H. W., Jennings, M. A., and Williams, T. I.: (1943) Brit. J. Exp. Path. 24, 108.
8. Coulthard, C. E., Michaelis, R., Short, W. R., Sykes, G., Skrimshire, G. E. M., Standfast, A. F. B., Birkinshaw, J. H., and Raistrick, H.: (1942) Nature, 150, 634.
9. Crowfoot, D., and Low, B.: (1944) Lancet, 1, 113.
10. Dubos, R. J., and Hotchkiss, R. D.: (1942) Trans. Coll. Phys. Philadelphia, 10, 11.
11. Dutcher, J. D.: (1941) J. Bact. 42, 815.
12. Gardner, A. D., and Chain, E.: (1942) Brit. J. Exp. Path. 23, 123.
13. Gordon, A. H., Martin, A. J. P., and Synge, R. L. M.: (1943a) Biochem. J. 37, 86.
14. Gordon, A. H., Martin, A. J. P., and Synge, R. L. M.: (1943b) Biochem. J. 37, 313.
15. Herrell, W. E., and Heilman, D.: (1941) J. Clin. Invest. 20, 583.
16. Hettche, H. O:: (1933) Klin. Wschr. 12, 1804.
17. Hettche, H. O.: (1934) Z. ImmunForsch. 83, 499.
18. Jones, H., Rake, G., and Hamre, D. M.: (1943) J. Bact. 45, 461.
19. Menzel, A. E. O., Wintersteiner, O., and Rake, G.: (1943) J. Bact. 46, 109.
20. Oxford, A. E., and Raistrick, H.: (1942) Chem. Ind. 61, 128.
21. Oxford, A. E., Raistrick, H., and Smith, G.: (1942) Chem. Ind. 61, 22.
22. Philpot, F. J.: (1943) Nature, 152, 725.
23. Rammelkamp, C. H., and Keefer, C. S.: (1941) J. Clin. Invest. 20, 433.
24. Rammelkamp, C. H.: (1942) War Medicine, 2, 830.
25. Raistrick, H., and Smith, G.: (1941) Chem. Ind. 60, 828.
26. Schoental, R.: (1941) Brit. J. Exp. Path. 22, 137.
27. Stuart-Harris, C. H., Francis, A. E., and Stansfeld, J. M.: (1943) Lancet, 2, 684.
28. Waksman, S. A.: (1943) J. Bact. 46, 299.
29. Waksman, S. A.: (1941) Bact. Rev. 5, 231.
30. Waksman, S. A., Horning, E. S., and Spencer, E. L.: (1943) J. Bact. 45, 233.
31. Waksman, S. A., and Tishler, M.: (1942) J. Biol. Chem. 142, 519.
32. Waksman, S. A., and Woodruff, H. B.: (1941) J. Bact. 42, 231.
33. Waksman, S. A., and Woodruff, H. B.: 1942) Proc. Soc. Exp. Biol. 49, 207.
34. Weindling, R., and Emerson, O. H.: (1936) Phytopath. 26, 1068.
35. Weindling, R., and Emerson, O. H.: (1936) Phytopath. 27, 1175.
36. White, E. C., and Hill, J. H.: (1943) J. Bact. 45, 433.
37. Wilkins. W. H., and Harris, G. C. M.: (1942) Brit. J. Exp. Path. 23, 166.

A New Approach to the Medical History of World War II

In preparing a history of its activities during the current war, the Medical Department of the Army is fulfilling an obligation to posterity and continuing a long-standing tradition of the Office of The Surgeon General. The medical developments fostered by this war are so extraordinary that they richly deserve a place in the annals of medical progress. Following both the Civil War and World War I, comprehensive histories were published under the respective titles *A Medical and Surgical History of the War of the Rebellion* and *The Medical Department of the United States Army in the World War.* These are notable chronicles which have extended the frontiers of medical knowledge and preserved the lessons learned in many fields of military medicine. The experience recorded in these volumes has been invaluable to those charged with the medical preparations for succeeding wars.

It should be a matter of satisfaction to all who serve in the Medical Department of the Army to know that in the midst of this global war plans for a medical history are rapidly maturing. The essential importance of this work has long been appreciated. Joseph J. Woodward, Major and Brevet Lieutenant Colonel, M.C., to whom was assigned the duty of collecting material for *A Medical and Surgical History of the War of the Rebellion* in a communication to The Surgeon General, on 20 October 1865, wrote: "A history becomes one of the most important duties of the medical department of the army; a duty the evasion of which would be a grave crime against the Army of the United States, and against every citizen who, in future wars, volunteers in defense of his country." These words should be a stimulus to all Medical Department personnel to contribute in some way to the medical history of World War II, and with that support it can become an enterprise of great value to future military medicine, as well as to mankind in general.

EARLY PLANS FOR A MEDICAL HISTORY

In view of the world-encircling activities of the Medical Department today, it is fortunate that an early start was made to record the great volume of work that is now under way. In July 1940, when the participation of the United States in the war still seemed remote, a group of professional men laid the groundwork for a medical history of the "emergency."

Prepared in the Historical Division of The Surgeon General's Office.

This group, the Subcommittee on Historical Records of the Division of Medical Sciences of the National Research Council, planned a series of volumes covering the professional phases of the nation's medical effort. The work of the Medical Departments of the Army and Navy, as well as the activities of the Public Health Service and all federal and civilian agencies engaged in medical defense, was to be included in a series of twelve or more volumes sponsored by the Subcommittee. Editorial assignments were made among physicians, both in the armed services and in civilian life. The Army Medical Department cooperated with this Subcommittee and was represented on its editorial board by Colonel Albert G. Love, who in August 1941 became the Director of the newly organized Historical Division of the Office of The Surgeon General. The Subcommittee on Historical Records has played an important role in shaping the historical program and in maintaining interest in it.[1]

The series of volumes proposed by the Subcommittee was to be primarily devoted to the professional aspects of war medicine. It was apparent that many of the essential services of the Army Medical Department would not fall within the scope of this limited program. Consequently, The Surgeon General authorized the preparation of an additional series of volumes dealing with medical administration, training, hospital construction, supply, finance, personnel, vital statistics, and the dental and veterinary services. These volumes were to be the responsibility of the Historical Division of the Office of The Surgeon General. When these plans were formulated, it appeared that a comprehensive historical account of medical activities could be achieved under the joint arrangement between the National Research Council and the Army Medical Department. The division of responsibility persisted until recently when it became evident that the Office of The Surgeon General should assume full authority for both the professional and administrative histories.

EXPANDED HISTORICAL WORK OF THE MEDICAL DEPARTMENT

The decision to assume responsibility for the entire historical series is based primarily on two factors: (1) The growth of the Medical Department's work and (2) the advantages of having the historical volumes written by medical officers with firsthand experience in the various professional and administrative specialties.

During the early phases of the emergency, our medical activities were limited to a small Army located within the continental United States. Since our country became an active participant in the war, the work has expanded beyond all expectations and made necessary a series of historical volumes devoted entirely to the Medical Department. If the

1. Love, Albert G.: Plans for a Medical History of the Emergency, Army Medical Bulletin No. 60, January 1942, pp. 24-37.

Department's work should be recorded along with that of other agencies, much valuable detailed material would be sacrificed. Hence separate volumes to be prepared entirely under the auspices of the Office of The Surgeon General are now planned in place of a joint series of volumes originally projected by the Subcommittee on Historical Records of the National Research Council.

It seems obvious that the writing of the Medical Department's professional and administrative volumes can best be done by those directly associated with the work. There is no substitute for the intimate experience gained by the officers so engaged and, in this connection, it is hoped that many officers in this country and overseas will keep records of their experiences. Personal observations frequently throw light on obscure problems and situations and they add zest and interest to material that otherwise might be no more than a straightforward record of facts. A great deal of valuable information is now reaching the Historical Division through annual reports, official correspondence, and other documents, but there is definite need for material from individual sources. It should be remembered that one does not have to be charged specifically with a historical assignment to lend a hand to those responsible for the preparation of the volumes.

Plans have now been perfected to launch the expanded historical program and to expedite the preparation of the volumes. All possible progress should be made now in order that the history may be published as soon as possible after the termination of the war. A coordinating committee comprising one representative from each of the Professional and Administrative Services of the Office of The Surgeon General, the Army Medical School, and the Army Medical Museum will assist the Director of the Historical Division in formulating policies and plans relative to the professional and administrative volumes. The Chief of the Preventive Medicine Service and the Directors of Divisions of Medicine, Surgery, Neuropsychiatry, Reconditioning, Physical Standards, Dentistry, and Veterinary Medicine will be responsible for outlining the contents, selecting the authors, collecting basic information, and supervising the final preparation of their respective volumes. Colonel George R. Callender, director, Army Medical School, will be responsible for the volume *Offensive Weapons in Relation to Injury.* Colonel James E. Ash, curator, Army Medical Museum, is to prepare a volume on pathology. Colonel Cornelius P. Rhoads, M.C., Office of the Chief, Chemical Warfare Service, will be asked to write a volume on the medical aspects of chemical warfare.

Inquiries will be welcome from officers in this country and overseas who desire further information or who wish to contribute to either the professional or administrative volumes. Material pertaining to administration, medical tactics, evacuation of the wounded, and the flow of supplies is par-

ticularly needed. The historical volumes should embrace a very full account of each of these features of the work of the Medical Department as the success or failure of medicine as applied to a military force rests on the proper solution of administrative and supply problems.

OTHER HISTORICAL ACTIVITIES

A constantly increasing interest in historical reporting in all federal departments has been apparent since the publication in the spring of 1942 of a letter written by President Roosevelt to the Director of the Bureau of the Budget stressing the importance of "preserving for those who come after us an accurate and objective account of our present experience." The paucity of records concerning World War I activities gave point to the President's message. In many instances there was need to draw on past experience in formulating current plans and frequently no records were available for guidance. Much work might have been expedited and many mistakes avoided had records of the past been available. It, therefore, seemed eminently worth while to establish historical services to record our present experience.

In accordance with the President's directive, instructions were issued by The Adjutant General to the commanding generals of the Ground Forces, Air Forces, and Army Service Forces to establish historical offices. The Medical Department is cooperating with the historical sections in Headquarters, A.S.F. and A.A.F. and has commitments to fulfill in connection with the work of each.

The Historical Section, A.S.F., plans to publish twenty-five popular or semipopular volumes of 100 to 150 pages devoted to an over-all picture of the work of A.S.F. during this war. Two volumes in this series, which will deal entirely with Medical Department activities, are tentatively entitled *Medical Developments of the War* and *Vital Statistics and Medical Administration.* Other volumes in the series will contain limited accounts of the Medical Department's experience with supply, training, operations, and other problems peculiar to the Department's mission. It is expected that the A.S.F. historical series will be published within six months following the cessation of hostilities.

The Office of the Air Surgeon is also actively engaged in compiling a historical series which will stress the developments of aeromedicine. The growing importance of this subject and the new facts gleaned from research in the hitherto unexplored field of aviation physiology bid fair to make these volumes an outstanding contribution to science. Close liaison exists between The Surgeon General's Office and the Air Surgeon's office in the preparation of these volumes. Definite publication plans are yet to be decided. An important historical activity is being conducted by the Intelligence Division, G-2, General Staff, with Lieut. Colonel John M. Kemper in

charge of the work. This historical section is sending trained personnel to the various theaters of operations to gather material "on the spot." The specific objective of this work is to collect information of technical value to troops in training. It appears probable that a series of volumes will be sponsored by G-2 which will include detailed records of military operations including the medical service.

The Medical Department is working in close relation with the G-2 historical staff and is adopting its method of dispatching historical officers to foreign theaters. At present historians representing the Medical Department are assigned to the Alaskan Defense Command, NATOUSA, SWPA, and ETO and assignments to other theaters are contemplated. The assignment of historical officers to the various theaters, it is believed, will result in accumulating valuable information that would otherwise never be recorded. A recent report from a Medical Department historian bears testimony to this fact. He wrote:

> I am particularly pleased to get the personal touches, the firsthand observations, and the local color which will add a great deal to the final history. I am using the interview technique which has been quite successful as a means of following up certain points and gaining additional information. I plan to visit various installations in this theater. Trips are a very real aid in this work. They afford a knowledge of the physical layout, a picture of the setting, and a feeling for the situation that any amount of reading in the files could not provide.

It is expected that the historical officers assigned to the various theaters will prepare full accounts of the organizational, administrative, and operational activities of each theater.

A unique phase of the historical program is to be carried forward by certain industries which produce the intricate and extensive medical armamentarium required by the Army. The achievements of manufacturers in a sense are part and parcel of the medical record of this war. Without drugs, instruments, and equipment the benefits of modern medicine could not be made available to the armed forces. It was felt by those who planned the program that provision should be made for a series of industrial histories and it was suggested to representatives of a number of leading manufacturers that they finance and publish a series of volumes covering their experience during the war. This proposal was favorably received by several groups of industries, and it is expected that these volumes will reflect valuable lessons which industry has learned under the impetus of the demands of war. While these volumes will be of immediate value to students of industrial developments, they will have a long-range value to the Medical Department in serving as "blueprints" for future procurement planning. The Historical Division will exercise editorial supervision over the industrial volumes. Otherwise the industries will assume full responsibility for writing,

financing, and publishing the historical accounts of their work.

The widespread effort being made throughout the War Department to record military history certainly will result in producing a library that will bring the story of our tremendous war endeavor into a unified whole. We should never lose sight of the fact that we are witnessing significant medical history in the making and the Medical Department is writing an important chapter of that story. Consider, for a moment, some of our historic accomplishments—the enormous production of medical supplies, the establishment of a far-flung chain of hospitals, the introduction of new medical techniques and therapeutic agents, the training of a multitude of skilled personnel, the great strides in research, the mobilization of medical equipment, the maintenance of the best health record and the lowest death rate in the experience of the Army. This is the stuff of which medical history is made. If the prospective volumes succeed in preserving a full account of these and other achievements, the Medical History of World War II will be a monument to the greatest and most successful job the Medical Department has ever performed.

Medical Service in the North African Campaign

MAJOR GENERAL ALBERT W. KENNER
U. S. Army

The Tunisian Campaign. It will be recalled that two task forces from England made initial and synchronized landings in French North Africa, one an American force at Oran, the other a British force at Algiers. They encountered relatively little resistance and speedily attained their objectives. Immediately following the armistice, by a sort of political metamorphosis, the French ceased to be an enemy and became an ally determined to expel the Axis forces from Africa. The British and American forces exploited their advantage and drove rapidly toward Tunisia. They encountered severe enemy reaction, however, to the west of Tunis from Von Arnheim's army and fell back on a line running roughly from Medjez el Bab south to Tebessa.

The situation as of the end of December 1942 was roughly as follows: An Allied force headquarters had been established at Algiers with General Eisenhower as commander in chief. The general and special staff sections were headed

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The first part of this article appeared in The Bulletin in May, page 76.

up by British staff officers in some instances and Americans in others, but in all staff sections each staff officer had his "opposite number." The surgeon of the Allied force was a British medical officer with the rank of major general. Bases had been established at Oran by the Americans and at Algiers by the British. British advance bases were operating at Philippeville and Bone about 300 miles to the east of Algiers. The American force was supplied by the British. A communication zone headquarters had been established at Setif by the British but was not operative at that time. There was no road net and only one railroad, single track, between Algiers and Constantine, with a maximum capacity of eleven trains daily. The main road from Algiers was tortuous, in a poor state of repair, and reduced convoy speed to an average of six miles per hour. The desert may be a tactician's paradise, but it is surely a quartermaster's "hell."

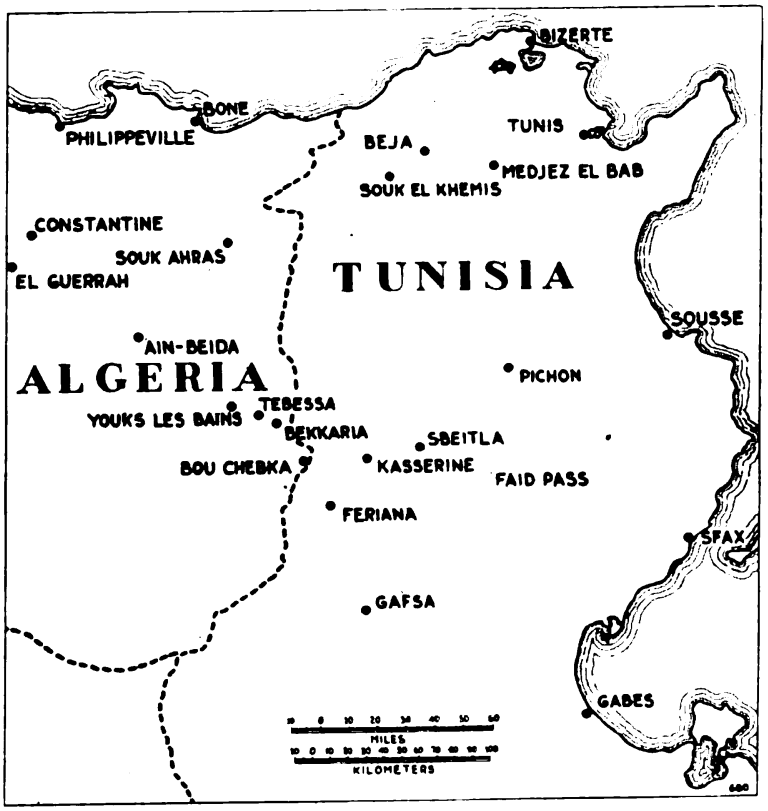

FIGURE 3

British First Army Headquarters was located at Constantine, about 200 kilometers from the front, with an advance echelon at Souk Ahras. The American force, operating as battalion and regimental combat teams, was then under the command of the commanding general of the British First Army. Later the American Second Corps was organized as an independent corps with headquarters outside Tebessa, 200 kilometers to the south of Souk Ahras and an equal distance from Constantine. A French force in the vicinity of Pichon was interposed between the British and American forces. The French force was composed of well-disciplined and trained professional soldiers but was inadequately equipped and had to be closely supported by American Air Forces, with headquarters at Tebessa. In the meantime, Montgomery's 8th Army was chasing Rommel's Axis army across

Libya and was approaching the Tripolitania and the Mareth Line. It became apparent that Rommel was trying to effect a junction with Von Arnheim, who had been greatly reinforced by troops flown to him from Sicily, and that a considerable increase in the activity of the Tebessa sector should be anticipated. With this in mind, the American Second Corps was organized with headquarters at Tebessa, about ninety miles from points where contact was had with the enemy. The troops of this corps were spread pretty thin, there was no front line as such, combat teams were not mutually supportive, and the sector was held with a prayer.

The difficulties attendant on the medical servicing of our troops should be apparent. It was obvious that medical units must have flexibility and mobility as their outstanding characteristics. They had to be adaptable to the operational procedures and tactical "maneuverability" of the troops they serviced and they had to be self-contained. Because of the distances involved, the inadequate communications in this region, and the essential time element, adequate surgical care had to be made available in forward areas.

Initially all hospitalization was a responsibility of the British, as the American troops were under British command. We were establishing general hospitals at Oran and evacuation hospitals were arriving from the United Kingdom; about all we had were the attached medical [units] and the medical battalions organic in the divisions. Our wounded were, therefore, cared for in British installations. The British medical service was echeloned pretty much as ours is. At Medjez el Bab, the battalion aid station was located in a railroad station. Patients were evacuated to a field ambulance (clearing company) located about two miles back, in a farm, under direct observation and within range of field artillery. Major surgery was being performed by well-trained surgeons. One patient who had a gunshot wound of the back and who had had a kidney removed a few hours previously was seen. Many cases of compound fracture due to high explosive had been adequately treated, and several brain cases had received emergency treatment. (These cases were later seen in a general hospital and were in excellent condition.) At Beja, about 40 kilometers to the rear, one field ambulance, capacity 200, was located in a school building. Its personnel was augmented by a surgical and shock team. These installations were evacuated by ambulance to a casualty clearing station (evacuation hospital) at Souk el Khemis, a distance of 27 kilometers. This installation was well equipped and well staffed. Major surgery was performed by the regular staff augmented by surgical teams and a transfusion unit. In passing, it may be remarked that the British use whole blood sent forward from bases in refrigerated units. Each transfusion unit has its own equipment which includes a refrigerator. From this, C. C. S. patients

were evacuated to Souk Ahras, about 80 kilometers, to a 200-bed general hospital located in a school. Evacuation of patients from Souk el Khemis was accomplished by a Michelin car, Diesel propelled on a narrow-gage track, carrying fourteen litters, and by ambulance. Evacuation to bases was accomplished by hospital trains.

The British general hospitals vary in size from a 200- to 1,600-bed capacity, established in buildings or tents, and are more mobile than ours. Their tentage is far superior to ours as it is double walled, ventilated, and lighted by windows, and is of black-out type. They have no organic transportation, are moved by the quartermaster, and have attached to them a platoon of sappers whose duties include the erection of tents, ditching, and road making. Their patients are subsisted on the field ration supplemented (as ordered by the surgeons) by what they call medical comforts. These medical comforts comprise soups, ale, canned vegetables, and other delicacies. They do not have the equipment or staffs of our general hospitals. American patients in British installations received excellent care, however, and formed quite an attachment for their British comrades.

With the formation of the American Second Corps, we took over the hospitalization of our own wounded, aided in small measure by the British who made available to us the twelve casualty clearing stations and some ambulances for evacuation to British hospitals in the vicinity of Constantine. These facilities were used only when weather conditions and enemy aerial activity precluded evacuation by air. With the distances involved, poor communications, and lack of adequate United States medical units, it soon became obvious that we should have to evacuate by plane. C-47 planes bringing supplies to the forward area returned to our bases with wounded. Returning by the southern route from Youks (15 miles west of Tebessa), fighter escort was not required and evacuation to base installations was accomplished in about four hours whereas it would have taken twenty-four hours by train or forty-eight by ambulance convoy. In some instances, three to four hundred wounded were evacuated by this means in one day. In many instances, men wounded in the morning found themselves in the operating theater of a general hospital at Oran in the late afternoon. In air evacuation, a holding unit must be operative in the vicinity of the field.

At the time of Rommel's break-through at Kasserine in February, medical units of the 2d Corps were disposed as follows: the surgical hospital, one hospitalization section, and the mobile surgical unit at Feriana; one evacuation hospital sited near Tebessa had 500 patients; another evacuation hospital was in reserve in the woods near Tebessa; one medical battalion had established a clearing station near Bekkaria, while another medical battalion was operative in the area

between Gafsa and Tebessa, a distance of about 100 kilometers. The corps, with its organization in depth, involved considerable distances. Axial evacuation from forward areas was slow because of the fact that there was but one road in this stretch of desert. Because of the loss of the Faid Pass high ground, the right flank of the corps was imperiled at Gafsa and the surgical hospital was moved from Feriana and sited at Bou Chebka. This movement was begun at 9:00 p. m. and completed by 6:00 a. m. by pooling the 2½-ton trucks of two medical battalions, the patients being evacuated to an evacuation hospital near Tebessa. At Sbeitla one medical company of an armored division had established a clearing station in which definitive surgery was performed. One battalion of a medical regiment set up a relay post near Kasserine in support of the station at Sbeitla. On the third day of the attack a retrograde movement of the surgical hospital from Bou Chebka to Youks les Bains was accomplished and this unit received patients from the evacuation hospitals which had to be moved about 70 kilometers back of Tebessa to Ain Beida. About forty-eight hours were required to effect the movements of the two evacuation hospitals by trucks controlled by the corps surgeon. Changes in the tactical situation forced a withdrawal of medical elements with combat units to the vicinity of Tebessa and Youks.

Patients were evacuated to Ain Beida and to a station hospital at El Guerrah by the ambulances of a medical battalion reinforced by a convoy of twenty-eight British Austin ambulances. All moves were made without incident and without loss of personnel or matériel despite the fact that the German was exploiting his initial penetration successfully. The training of medical personnel paid big dividends during this action as only well-trained personnel could have cleared a surgical hospital of 125 patients and loaded in four and one-half hours. All patients in these mobile medical units were evacuated safely to the communications zone and none were abandoned to the enemy. Evacuation by air from Youks to base hospitals was utilized until loss of forward air fields prevented its further employment.

These experiences emphasized the importance of flexibility and mobility of medical units in a forward area and the absolute requirement that medical troops be trained to the highest degree of efficiency in the doing of those things required of them in combat. The lifesaving qualities of blood plasma were demonstrated in innumerable cases, and the early application of proper surgical measures, supplemented by the sulfa drugs, resulted in a reduction of mortality rates without precedent.

Original Articles

Fumigation of Army Buildings

FIRST LIEUT. W. D. REED
Corps of Engineers, Army of the United States

The release of a toxic gas inside an enclosure is an old method of pest extermination. Sulfur fumes were employed in chemical warfare by the Greeks in 673 A.D. A burning mixture of pitch, sulfur, quicklime, and petroleum was known as "Greek Fire." Callinicus, a Syrian, is said to have invented this mixture and through its use saved Constantinople from capture by the Saracens for about four years (673 to 677 A.D.). Many other chemicals have been used for fumigation, all of which have certain hazards. For many years a search has been made to find the ideal fumigant.

CYANIDE FUMIGATION

Hydrocyanic acid gas is the nearest approach to an ideal fumigant. Small amounts released in enclosed spaces kill all animal life therein, but when liberated its dissipation into open air is so rapid that quantities much larger than are used in fumigation would be required to harm human beings. This gas is very penetrating, has a high specificity for roaches and bedbugs, and rapidly diffuses out of materials it has penetrated. Condensation occurs at temperatures below 40° F. and this condition greatly delays removal of the hydrocyanic acid gas by aeration.

Hydrocyanic acid is fatal to man and must be handled with care. Fumes released from this acid are hydrocyanic acid gas(HCN) and, when applied as a fumigant, are hazardous to human life. These hazards can be eliminated by meticulous care. If handled by persons who employ the safeguards recommended, no danger is involved in its use in Army buildings, but if applied by ignorant, reckless, or careless individuals, fatal accidents may result.

In cold weather, water absorbs large amounts of hydrocyanic acid gas and moist articles fumigated will require a longer period for airing. Mattresses, pillows, blankets, field equipment, and clothing may absorb the gas, especially at low temperatures, and care should be taken in aeration of

Paper presented at conference of Sanitary Corps officers, S.G.O., Washington, D. C., 14 February 1944.

these articles. Solid foods absorb some of the gas but not in dangerous quantities at the dosages recommended for fumigation of Army buildings. Soft foods such as butter, milk, jellies, jams, and cheese should not be exposed to the gas. It can be used with safety on guns, munitions, leather goods, and individual equipment stored in supply rooms and warehouses.

The physical properties of liquid HCN (96/98 percent) are as follows:

Boiling point, normal atmospheric pressure 79.7° F.
Freezing point, normal atmospheric pressure 5° F.
Specific gravity of the liquid 0.6970.
Specific gravity of the gas (air=1) 0.9348.
Molecular weight 27.
Explosive limits, lower limits placed at 5.6 percent to 12.8 percent volume concentration of the HCN.
Fumigation concentrations, ¼ to 1 percent volume concentration of the HCN (this is far below the explosive limits).

The reported toxicity of hydrocyanic acid gas to man and domestic animals is briefly summarized as follows:

20 to 40 parts per million in air of HCN—slight symptoms after several hours of breathing.
50 to 60 parts per million in air of HCN—serious disturbances after breathing for one-half to one hour.
120 to 150 parts per million in air of HCN—dangerous in one-half to one hour.
150 to 300 parts per million of HCN in air—quickly fatal to man and animals.

METHODS OF APPLICATION

Hydrocyanic acid with the resulting gas when released was discovered accidentally in the eighteenth century, and it was at that time given the name "prussic acid." It was first used for fumigation in 1886, the gas being generated by placing a mixture of potassium cyanide, hydrochloric acid, and water in a suitable earthenware crock or wooden barrel. Later the ingredients were changed to a mixture of sodium cyanide, sulfuric acid, and water which gave a better yield of gas. Its use was authorized by U. S. Quarantine Regulations in 1910 and was extensively used in Puerto Rico in 1912-1913, and by the U. S. Public Health Service in plague control work in New Orleans in 1914.

Since 1918, liquid HCN has been used almost exclusively for large-scale fumigation of buildings such as flour mills, and warehouses filled with tobacco, flour, beans, peas, rice, and

upholstered furniture. Further research with liquid HCN developed a method of absorbing it in cellulosic disks which could be packed in cans made of blocked tin or turnplate containing 2½ pounds each of the acid. This method was developed for household fumigation and other small-scale jobs where the application of the liquid from heavy steel cylinders was hazardous, but it is a convenient method of release for fumigation of buildings on Army posts.

Hydrocyanic acid is applied as a fumigant by one of the following methods:

1. "HCN Discoids" packed in tin cans each containing 2½ pounds of liquid HCN.

2. The gas is generated on the premises usually inside the space to be fumigated by placing a mixture of sodium cyanide, sulfuric acid, and water according to the formula 1-1½-2, in a suitable earthenware crock or wooden barrel.

3. It is supplied as liquid hydrocyanic acid in steel cylinders and forced under pressure from steel cylinders through a piping system into the space to be fumigated.

4. It is supplied as calcium cyanide in powder form, and when applied in rat burrows or ant hills, HCN is given off slowly in the presence of moisture. This is the form recommended for the control of rats in outside burrows and ants. (Post supply officer, item No. 51-C-418)

5. "Safti-fume," consisting of sodium cyanide and sodium chlorate mixed with sand and other inert ingredients in the form of briquettes, which when placed into wooden buckets or other containers with a given amount of diluted hydrochloric acid gives off HCN and cyanogen chloride.

FUMIGATION OF ARMY BUILDINGS

Most buildings fumigated on Army posts to date have been 63-man barracks, 74-man barracks; bachelor officers' quarters, barracks type; civilian housing, barracks type; and mess halls. Recommendations for the fumigation of this group of buildings as approved by the Medical Department and the Corps of Engineers are set forth in War Department pamphlet 5-1 issued 13 December 1943.

Fumigations conducted on Army posts should be under the strict supervision of the post engineer and conducted in accordance with the recommendations and direction of the post surgeon. Post engineers are not authorized to fumigate any building at posts, camps, and stations until it has been inspected by a representative of the post surgeon and certified as being infested. The recommended procedure for cooperation in fumigation work between the post surgeon and the post engineer is as follows:

1. Infestations that cannot be controlled through "good housekeeping" by troop units should be reported by unit commanders to the post surgeon or reported by the inspector from the post surgeon's office during regular post inspections.

FIGURE 1. Trucks with supplies for sealing and fumigating barracks.

2. The post surgeon should certify to the post engineer the buildings recommended for fumigation.

3. The post engineers should have the necessary supplies on hand to proceed at once to fumigate the building and make arrangements to include vacating all occupants, sealing, barricading, placing of guards, and the application of HCN discoids by a trained fumigation team (see figures 1 and 2).

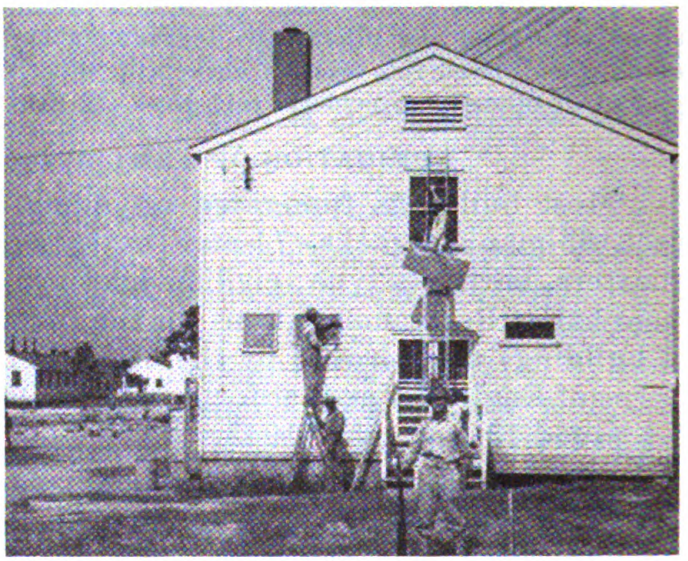

FIGURE 2. Sealing ventilators and louvers on barracks prior to fumigation, showing armed guards on duty.

4. The following should be notified when the building is ready for fumigation: post surgeon, officer of the day, safety director, and fire marshal.

5. Prior to release of the hydrocyanic acid gas, a representative of the post surgeon should accompany the post engineer dur-

Photographs by U. S. Army Signal Corps.

ing an inspection of the sealed building to determine that it has been completely vacated and that all sealing and inside preparations are properly carried out. Armed guards, preferably military police, should be stationed outside the building scheduled to receive treatment (see figure 3).

6. When the building is ready, the trained fumigation team from the staff of the post engineer should enter the building by the door left unsealed. Each man should be wearing a gas mask properly fitted and should be equipped with a *special HCN canister*. The cans of HCN discoids should be opened with precision and speed and spread on the floor of the building (see figure 4).

FIGURE 3. Arrangement of bedding, footlockers, and clothing in barracks for fumigation.

7. The fumigation team should leave the building immediately after applying the HCN discoids and seal the exit door.

8. At the end of the period of exposure the fumigation team should return to the building, don the gas masks, and open the outside doors. A fifteen-minute interval should be allowed to elapse before entering. The team, wearing gas masks, should then enter the building and open all remaining doors and windows. Aeration should continue for at least four hours with the open doors barricaded and containing warning signs. Guards remain on duty during this period.

9. At the end of the period of aeration, the post engineer and representatives of the post surgeon should inspect the building, wearing masks until tests with methyl orange test paper indicate that dangerous concentrations of HCN are not present in the building or its contents (see figure 5). The building is then declared by the post surgeon to be free of gas and ready for occupancy by troops or other personnel, and all officers concerned are notified of this clearance.

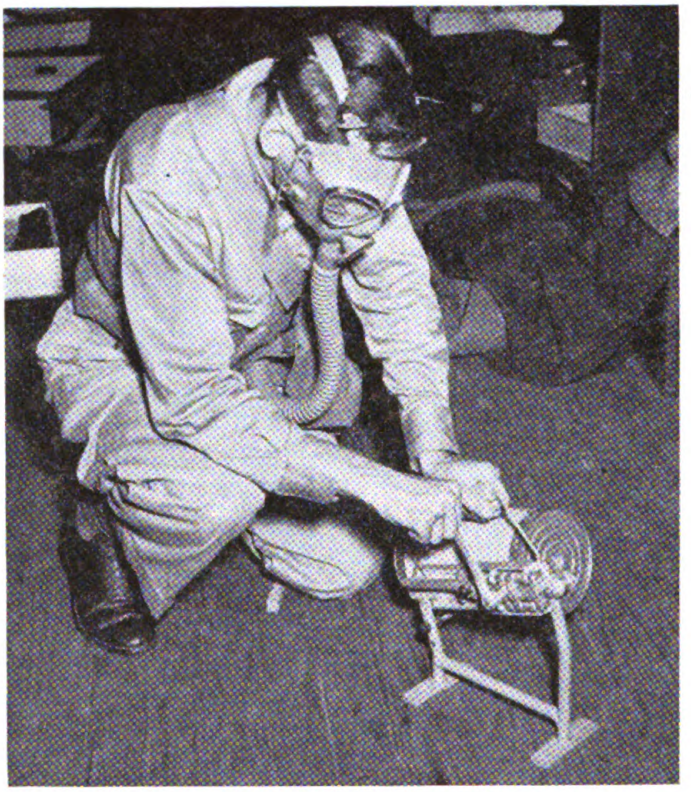

FIGURE 4. Opening can of discoids prior to spreading them on the floor for fumigation.

10. The spent discoids on the floor contain no gas and are harmless, but should be swept up and burned or otherwise destroyed, and the tin containers should be salvaged in accordance with post regulations.

BUILDINGS THAT PRESENT SPECIAL PROBLEMS

In addition to barracks and mess halls, other types of building on Army posts may occasionally require fumigation. Included in these are bachelor officer quarters, family residences, civilian housing, post exchanges, officers' clubs, service clubs, theaters, nurses' quarters, theater-of-operations type buildings. Some of these are permanent structures made of brick, reinforced concrete, or other high-grade building materials. Such buildings may include connecting rooms, partition walls, closets, and bathrooms. Interior furnishings may vary greatly, consisting of rugs, upholstered furniture, or other furniture and supplies.

When necessary to fumigate these buildings, each one will present a special problem. Methods of sealing, dosages of HCN discoids, and periods required for aeration may have to be

changed to suit the particular condition. No part of any building should be fumigated until the post surgeon certifies to the need for fumigation. Entire buildings should be closed even if only one room is to be fumigated, as HCN readily penetrates partition walls. Technical assistance may be requested from service command headquarters for these special problems of fumigation.

In most instances greater care must be exercised in sealing, and the dosage of discoids should be increased to about 8 ounces per 1,000 cubic feet. When these higher dosages are used, the

FIGURE 5. Distribution of disks in mess hall.

period of exposure should be extended to twelve hours and the period of aeration to twelve hours. Guards should be posted, preferably military police, during the entire period of fumigation and aeration. All outside doors should be closed and barricaded and the approved warning sign prominently displayed. The barricade strips should remain on open doors during the aeration period. Occupants should not re-enter until methyl orange test papers indicate that the gas has dissipated from all parts and furnishings of the building and the post surgeon has released it as safe.

WARNING GASES IN CYANIDE FUMIGATION

Many authorities have suggested that a warning gas added to HCN would increase the margin of safety in its use. Attempts were first made to do this by the U. S. Public Health Service working in cooperation with the Chemical Warfare Service. Experiments led to the development of a mixture of sodium chlorate and sodium cyanide which, when placed in a mixture of hydrochloric acid and water, generated a mixed gas consisting of about 70 percent HCN and 30 percent cyanogen chloride. This mixture made use of the pot method for generating the gas.

FIGURE 6. Fumigation of quartermaster supplies. Note the boards between the rows of blankets.

When liquid HCN was developed about 1918, liquid cyanogen chloride (about 20 percent) as a warning gas was incorporated with liquid HCN (about 80 percent). This mixture was unsatisfactory. Later, chloropicrin was tested as a warning gas in HCN. This proved superior to cyanogen chloride and was adopted by the U. S. Public Health Service as being the most satisfactory warning gas. It is still used to some extent in public health work where local administrators require it.

Cyanide producers have for years been searching for a satisfactory warning gas. If it is found, its use with HCN would be made compulsory. A great number of compounds have been tested and none are considered of much value.

The properties of a satisfactory warning gas are summarized below, including the shortcomings of cyanogen chloride and chloropicrin:

1. The warning gas should not react with the HCN itself.

2. A strong physiological reaction of the tear gas on man is not desirable, as the blinding, choking effects of the tear gas have prevented men from holding their breath and getting out of fumigated spaces.

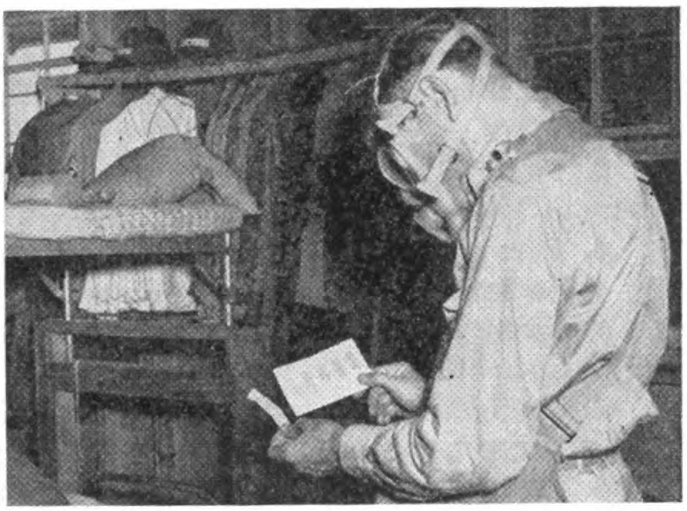

FIGURE 7. Representative of post surgeon making tests with methyl orange test paper for clearance of building after fumigation with HCN discoids.

3. An ideal warning gas should have a strong odor but not be highly irritating to the eyes, nose, and throat.

4. A satisfactory warning gas should have about the same vapor density as HCN. According to Graham's Law, the diffusion of a gas is inversely proportional to the square root of its absolute density. Hydrocyanic acid having a specific gravity about 0.4 that of cyanogen chloride diffuses 1.5 times as rapidly. The result is that HCN can rapidly pass through walls or other media leaving the cyanogen chloride behind. In the case of chloropicrin the HCN will diffuse more than twice as rapidly.

5. The warning gas should not corrode metal objects (chloropicrin is more desirable than cyanogen chloride in this connection). It is the consensus of workers in the field of gases used in fumigation that warning gases so far developed do not appreciably minimize the risks of fumigation. On the basis of present information, it cannot be said that HCN containing a warning gas is safer for use in fumigation than HCN alone.

DANGERS FROM FUMIGATION

Fumigation of Army buildings can be done safely by intelligent operators who follow safe procedures. The following are ways in which accidents or fatalities may occur in Army fumigation.

1. Failure to post guards prior to release of gas. Men or domestic animals must not approach closer than 30 feet to treated buildings.

2. Operators, careless in opening cans of discoids, exposing themselves to unnecessary concentration of gas (skin absorption may result).

3. Faulty gas masks, poor fit of mask, and defective or worn-out HCN canisters.

4. Permitting men or domestic animals to hide in buildings to be fumigated and escape detection on final inspection.

5. Fumigating part of a building without having entire building vacated.

6. Fumigation by contract without certification of buildings by post surgeons and supervision by post engineers.

7. Failure to aerate buildings properly and to check concentration of gas present with methyl orange test papers.

8. Allowing careless, reckless, or ignorant persons to apply HCN and be responsible for aeration of the building.

SUMMARY AND CONCLUSIONS

In the present program, no accidents have been reported where trained personnel have applied discoids under the supervision of the post engineer.

This is a dangerous gas, but it is being handled with safety both to the operators and to the Army personnel occupying the treated buildings.

Bedbugs, cockroaches, and other household pests affect the health and morale of the fighting forces and must be controlled. Careful consideration has been given to the most effective and economical methods of control of these pests. All measures included under good housekeeping should be carried out to reduce the amount of fumigation required.

When fumigation becomes necessary, hydrocyanic acid gas in the form of discoids is the most effective and economical gas for use in this work. If proved safeguards, such as are outlined in W. D. Pamphlet 5-1 and further amplified in this paper, are used, it can be applied with absolute safety. Accidents that may occur will be due to the work of ignorant, careless, or reckless operators. Post engineer should always use trained personnel.

Coronary Occlusion in a Race Horse

MAJOR RICHARD T. GILYARD
Veterinary Corps, Army of the United States

Sudden death in equines from circulatory failure is not uncommon. Horses drop dead while at work or in sport and sometimes a sudden death without violence will occur in the stable. In three cases previously autopsied by the writer, no gross pathology of the heart or great vessels was determined. Death was attributed to functional heart failure, but curiosity persisted as to the true cause. In human medicine occlusion of the coronary arteries is commonly recognized. The human coronary subject is frequently a man who works long and strenuously under emotional strain.

Horses resemble man in nervous temperament to the extent of manifesting passionate dispositions and distinct personalities, and they are highly responsive to emotional stimulation. On 1 January 1944, at a race meeting in Trinidad, an equine case in this category was observed.

CASE REPORT

A six-year-old, West Indian bred, thoroughbred gelding was left at the post in a mile and 130-yard race. His history revealed that he was of erratic disposition and that he had developed anhidrosis two seasons previously. His skin and hair coat were always dry, regardless of the extent of physical exertion. When the field had covered a furlong, he got away and went the distance of the race under considerable persuasion by his jockey. While jogging back to the paddock he suffered a spasmodic seizure, sprang into the air, and fell dead.

NECROPSY

His hair coat was dry; the visible mucosae were injected. A routine autopsy revealed slight enlargement of all parenchymatous tissue. The lungs weighed 15 pounds and the spleen 12 pounds.

The heart and great vessels appeared normal in size and structural features. Both ventricles contained postmortem clots. A dissection of the coronary arteries was begun at their aortic origin. In the middle third of the right artery an adherent thrombus completely obliterated the lumen of the vessel and was removed with difficulty. The thrombus was dull in color, as compared with the shiny surface of postmortem clots, and friable, rather than elastic or jelly-like. At this point dissection was continued by making a series of small blocks, each containing a section of occluded artery and the adjacent coronary vein surrounded by muscle. The organized and inelastic appearance of the thrombus persisted at each bifurcation and into the smallest terminal branches of the vessel. The arterial structure and

The Trinidad Turf Club afforded the privilege of performing the autopsy. Stanley F. Yolles, U. S. Army Sector Laboratory, provided the photomicrograph.

its course remained normal. There was no evidence of myocardial fibrosis to suggest a previous dysfunction and spontaneous accomodation. The endothelium appeared smooth and the lumen not constricted.

Microscopic sections of the artery with thrombus in situ also illustrate characteristics of antemortem thrombosis with no evidence of arterial pathology, embolism, or canalization of the thrombus. The left coronary artery revealed a sparse, smooth-surfaced, elastic, and readily removed clot. These characteristics illustrate a postmortem change.

Marcenac and Gadiou describe a case in a mule as angina pectoris.[1] After severe exertion there were anxiety and pain followed by death in prostration in a few hours. The postmortem revealed a tortuous course of the artery, imbedded in a gelatinous mass, together with multiple myocardial indurations. No other reference to pathology of the coronary artery in equines is available at this time.

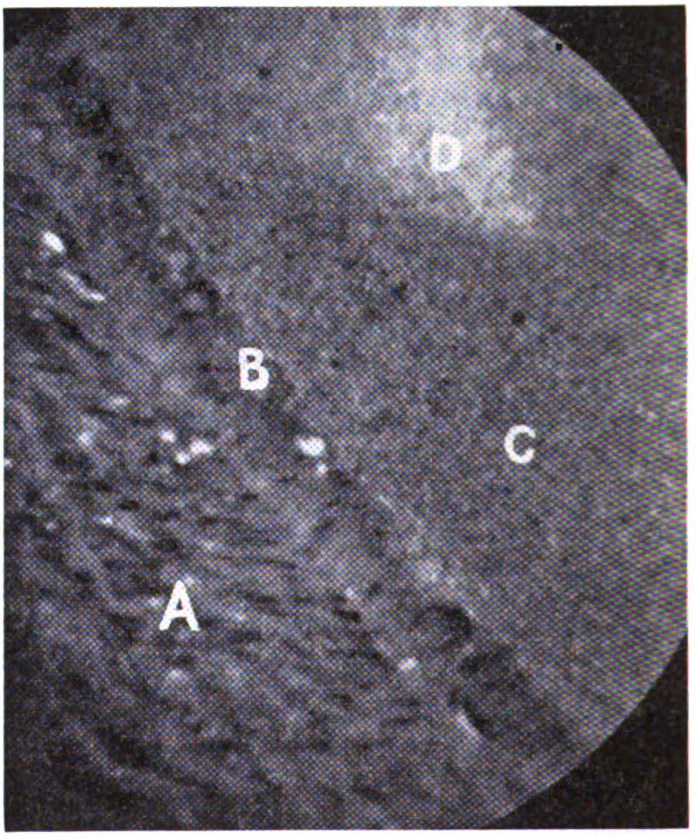

FIGURE 1. Section of right coronary artery in the middle third illustrating antemortem thrombosis: *A*, artery; *B*, proliferation of endothelial cells; *C*, homogeneous red cell clot; *D*, fibrin formation.

SUMMARY

Sudden death of a thoroughbred gelding following violent exercise under the emotional strain of racing suggested acute circulatory failure. An antemortem thrombus was demonstrated throughout the terminal two-thirds of the right coronary artery. No arterial or adjacent myocardial disease was apparent. It is believed that a spasm of the right coronary artery diminished the blood flow to a point of coagulation before death and that the resultant complete occlusion of the artery at the middle third of its course terminated the blood supply to the right side of the heart, producing myocardial failure and death.

1. Hutyra, F., Marek, J., and Manninger, R.: Special Pathology and Therapeutics of the Diseases of Domestic Animals, 4th English ed., vol. II, p. 679. London: Bailliere, Tindall, and Cox, 1938.

Injuries Incurred on Obstacle Courses

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In the last year, about 300,000 "runs" have been made over the two obstacle courses at our camp. The injuries that occurred will be analyzed

An obstacle course is an oval track containing hurdles, walls, ditches, and the like aimed to develop a soldier's poise and confidence under trying circumstances. While there is no limit to either the length or variety of an obstacle course, some are 163 yards long and contain ten obstacles. Obstacle courses are available at training camps all over the country. They are also well known among foreign nations.

The two courses at our camp have produced in about a year 38 injuries of sufficient severity to require hospital care with a time loss totaling 988 days and varying from 1 day to 193 days. The average loss per man was 26 days. Men who had been in the Army six months or less sustained 58 percent of the injuries. Of this latter group half had been in the Army one month or less.

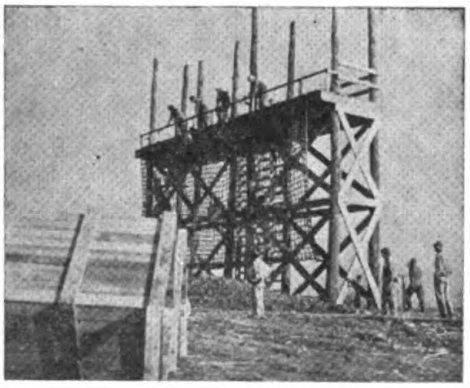
The ambitious "desk soldier" should be wary. Older men are more likely to be hurt; 19 percent of the injuries were in men of 35 years and above; about 30 percent of cases in which the weight was recorded weighed 175 pounds and above. One man, 6 feet 3 inches tall and weighing 232 pounds, was injured when a rung on a log ladder broke.

The lower extremities, particularly ankles and feet, bore the brunt of the injuries. Sprained ankles were the most frequent type of injury. Injuries of the knee numbered 7, with 2 mild injuries about the hip. There was 1 recurrent dislocation of the shoulder and 1 fracture of the greater humeral tuberosity, 2 mild cerebral concussions, one associated with a back sprain, and 2 cases of mild low back sprain.

Major Lewis W. McIntire, T. C., and First Lieut. Carl E. Barker, Jr., T. C., assisted in this study.
Illustrations from The Medical Soldier. Courtesy of the Harman Press, Harrisburg, Pa.

There were 4 serious fractures of the os calcis, three unilateral, one bilateral. Four men lost a total of 613 working days, an average of about 5 months apiece, in striking contrast to an average loss of 11 days per man for all the other injuries.

The small bones and ligaments of the feet by their resiliency normally take up the physical shock of jumping and landing on the toes. When this mechanism misfires, the heels suffer the shock of the entire body weight and injury results. The "tank trap," which combines both jumping from a height and straddling a ditch, has been the site of our serious heel cases. A lowering of the wall height and a narrowing of the width of the ditch has eliminated such injuries. In 8 of these cases the injury was produced by the usual misstep. In 26 cases, the injury could be definitely ascribed to the obstacles themselves. Twelve men were injured straddling a wide ditch; 9 as the result of falling from a high wall or ladder; and 5 injuries occurred going over low hurdles.

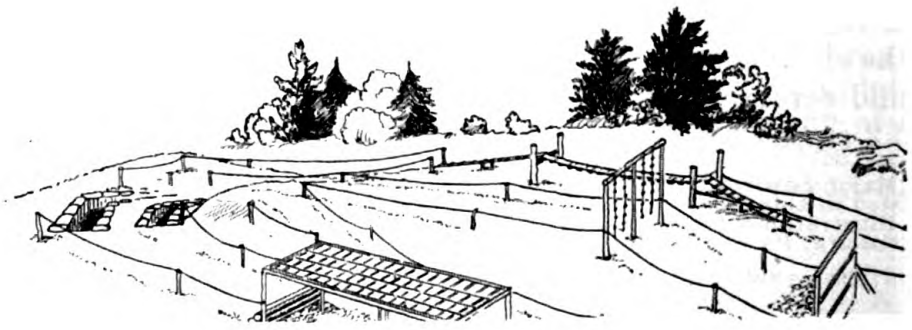


CONCLUSIONS

1. Obstacle course injuries are infrequent, but their potential manpower loss is important. Fractures of the os calcis created the greatest time loss in this series.

2. A commissioned officer must always be present to supervise use of the course and to keep misfits or ill men from going through.

3. There are signs posted on our courses warning the men, first, to walk through and observe the obstacles; second, to run through slowly; and third, to run through in a normal manner. They are urged to avoid accidents.



4. The untrained, the man approaching forty years of age, and the colored soldier are most likely to be injured and need close supervision.

5. Men have been hurt because they misunderstood and attempted to jump across a big ditch which they were supposed to jump into and then climb out. Tell the soldier exactly what he is supposed to do at each obstacle.

6. Keep a record of where accidents occur. An unusual number of injuries at any point is a warning to modify that particular obstacle.

7. Build the obstacles strong to withstand rough usage and check all obstacles periodically to keep them in repair. Do not wait for an accident—*prevent* it.

Trench Foot

CAPTAIN ROBERT C. BERSON
Medical Corps, Army of the United States
and
CAPTAIN RALPH J. ANGELUCCI
Medical Corps, Army of the United States

Baron Larrey[1] described the ravages of cold during Napoleon's ill-fated attack on Moscow and was the first to recognize the condition now known as "trench foot." He showed that the extreme cold was not responsible but that it was lesser degrees of cold associated with dampness; nevertheless, the armies engaged in 1914 were not prepared for the great number of cases which the special conditions of static trench warfare produced. Since then, however, many articles and much experimental work have added to our knowledge of the pathology of trench foot.

Lake[2] found that explanted heart tissue growing vigorously in vitro could be stored at 0° C. sometimes for weeks in complete inactivity but would resume growth and pulsation when the temperature was again raised. When the vitality of these reactivated, cold-stored explants was tested, in no way could they be distinguished from other tissues in which life had been maintained at normal temperature. Lewis[3] and Lake[2] found that when tissue cultures were exposed to temperatures of about -5° to -7° C. permanent death occurred promptly. This temperature range included the point of solidification of

1. Larrey, D. J.: Memoires de Chirurgie Militaire, p. 60. Paris: J. Smith, 1812.
2. Lake, N. C.: Report upon an Investigation into the Effects of Cold upon the Body, Lancet. Lond., 2:557-562, Oct. 1917.

the cellular protoplasm. Observation of the intracellular structure after such exposure showed that the protoplasmic framework was disrupted. Lake showed that the survival rate of tissue exposed to temperatures between 25° and 10° C. was shorter than in tissue exposed to temperatures of 0° to 10° C. Smith, Ritchie, and Dawson[4] experimentally produced a condition closely resembling "trench foot" by exposing rabbits to wet cold under varying conditions. It was found that division of the somatic or the perivascular sympathetic nerve supply failed to prevent the effects of the exposure; indeed, in the latter the manifestations of pathology were more severe than in the controls. In the vascular experiments, it was obvious that any means of restricting the blood supply during the thaw period was of value. Local vasoconstrictors were used and it was shown that gangrene of the skin of the exposed foot was consistently prevented by tying the main artery of the limb. In human experiments the effect of exposure of small areas of skin was often abolished by using local vasoconstrictors (adrenalin), while in the control areas the skin sloughed and left permanent scarring. It was also observed that multiple incisions or punctures which allowed the exudate to escape would prevent gangrene. Lewis showed that cooling the body as a whole results in peripheral vasoconstriction, which in turn encourages cooling of the extremities. It appears, therefore, that the following are factors in the damage caused by cooling:

1. The critical temperature for cooling tissues appears to be in the region of -5° to -7° C. Tissues cooled below this temperature are killed by disruption of their intracellular protoplasmic structure.

2. Down to the critical temperature cold has no detrimental effect on the individual cells of any tissue.

3. Exposure of parts of the intact animal to cold above the critical temperature results in retention in the tissues of metabolites which, during the period of thaw, cause a violent vascular reaction leading to transudation of fluid from the vessels. The transudation may be sufficient in amount to be important in causing gangrene.

"Frostbite" is a term that should be reserved for the condition in which tissues have been cooled below the critical temperature. "Trench foot" is a term which should be reserved for feet which show evidence of damage due to cooling above the critical temperature.

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3. Lewis, T.: (1) Observations on Some Normal and Injurious Effects of Cold upon Skin and Underlying Tissues; Reactions to Cold, and Injury of Normal Skin (Holme Lecture), Brit, M. J., 2:795-797, 6 Dec. 1941. (2) Observations on Some Normal and Injurious Effects of Cold upon Skin and Underlying Tissues; Chilblains and Allied Conditions (Holme Lecture), Brit. M. J., 2:837-839, 13 Dec. 1941. (3) Observations on Some Normal and Injurious Effects of Cold upon Skin and Underlying Tissues; Frostbite (Holme Lecture), Brit. M. J., 2:869-871, 20 Dec. 1941.

4. Smith, J., Ritchie, J., and Dawson, J.: Clinical and Experimental Observations on the Pathology of Trench Frost-bite, J. Path. Bact., Lond., 20:159-190, 1915.

CLINICAL PICTURE

The victim does not always recognize the onset of trench foot, for, although the initial exposure may produce uncomfortable sensations of coldness on the surface, as the deeper tissues are chilled local anesthesia develops and the parts become relatively insensitive. In this numb state small traumata which may have serious consequences later will pass unnoticed. With a rise in temperature the first sign of trouble is revealed by swelling with a dusky pallor followed later by an intense flush. This is the stage of maximum pain. If of slight severity the swelling lasts several days and then begins to subside with concurrent change of the color to normal. The surface layers of the epithelium may desquamate and paresthesiae may remain for a long time. In many instances the skin subsequently becomes thin and cold and shows delayed return of normal color after pressure. There may be some apparent shrinkage of the subcutaneous tissue.

In severe cases the swelling and the discoloration are more marked, blisters form, portions of skin become gangrenous and the vasodilatation and transudation are so marked that the area of red, hot, tender, edematous skin may extend well up the legs. In very severe cases the picture is exactly that of dry gangrene of the distal portion of the extremity and this gangrene may be clinically indistinguishable from that of true frostbite. When the stage of vasodilatation and transudation have passed, it is usually surprising how little tissue has actually become gangrenous. The rate of recovery seems to be inversely proportional to the severity of the disease but this is not an absolute relation.

ANALYSIS OF CASES

Among 144 cases of trench foot in this hospital, 9.7 percent had a family history of diabetes, 33.3 percent a family history of hypertension, 27.6 percent a past history of symptoms from exposure of the feet, and 86.2 percent a history of smoking. Among 877 other patients in this hospital for other conditions, none of whom had symptoms from exposure of the feet, 13.3 percent had a family history of diabetes; 32.8 percent a family history of hypertension; 26 percent a past history of exposure; and 87.6 percent a past history of smoking.

This is presumptive evidence that a past history of symptoms from exposure, a family history of diabetes and hypertension, and a past history of smoking are not important predisposing factors.

TABLE I

	Total	Mild	Mod.	Severe	Avg. exp.	Avg. age
Past history of exposure	52	34	12	6	9.6 days	22.7
No past history of exposure	41	14	16	11	8.0 days	22.6

A group of patients with a past history of symptoms from exposure was compared with a consecutive series of patients without such history (table I). It seems that the past history of symptoms from exposure did not influence the amount of exposure necessary to produce trench foot, the severity of the damage, nor the age at which the condition developed.

TREATMENT

A series of 88 consecutive cases was divided into three treatment groups. The first group was given a regular hospital diet, absolute rest in bed, and as much codeine as required to keep them fairly comfortable. The second group was in addition given Buerger's exercises four times daily under the supervision of a trained ward man. The third group was given no exercise but was given 50 mg. of thiamin chloride hypodermically twice daily. The variations in severity were about the same in the three groups. No cases of gangrene were included. These patients were under observation for an average of fourteen days. We were unable to demonstrate or detect any significant difference in the comfort, amount of sedation required, or the rate of recovery in the three groups.

Several writers [5] [6] [7] have suggested that block of the sympathetic ganglia with novocain might be helpful in this condition. Unilateral novocain block of the lumbar sympathetic ganglia was done in 20 cases. Four of these cases were characterized on the fourth day of illness by massive bilateral edema of the feet and ankles and markedly increased temperature of the skin of the feet, but without evidence of gangrene. Normal arterial pulsations were easily palpable in all. In each case satisfactory block was obtained as judged by prompt flushing of the skin of the whole leg and corresponding increase in the skin temperature as compared to the uninjected leg. In no case was pain a prominent part of the picture nor was it apparently influenced by the block. There was no decrease in tenderness. The swelling gradually subsided in several days but in each case the rate of improvement was the same as in the untreated extremity.

Ten milder cases with marked pain and tenderness equally distributed in both feet, normal palpable arterial pulsations, and no gross edema were blocked unilaterally in a similar manner. Seven of these cases had a temporary diminution in pain and tenderness but at the end of six hours there was no evidence of any difference between the two feet, nor was the course of the disease in the treated foot different from that of the untreated one during the next two weeks.

The third group unilaterally blocked comprised six cases of bilateral, cool, painful feet in the late stage of the disease,

5. Bigelow, W. G.: Modern Conception and Treatment of Frost-bite, Canad. M. Ass. J., 47:529-534, Dec. 1942.
6. Burdenko, N. N.: The Effect of Frostbite on the Sympathetic Nervous System, Am. Rev. Soviet M., 1:15-22, Oct. 1943.
7. Wright, I. S., and Allen, E. V.: Frostbite, Immersion Foot, and Allied Conditions, Army M. Bull., 65:136-150, Jan. 1943.

all with absent or barely palpable dorsalis pedis and posterior tibial pulsations. The immediate effect of block in these cases was typically vasodilatory with marked relief of pain which persisted even after the vasodilatation had subsided. In two cases a second block was done eighteen hours later on the same side and further relief obtained. That the rate of improvement in these cases was accelerated in the treated foot was evidenced by complete freedom from symptoms and the ability to bear weight on the treated foot about one week before similar function could be carried out by the untreated foot.

In the folklore of the Esquimaux, vague ideas have been expressed about the application of cold to tissues damaged by cooling. Recently the experimental work of Brooks and Duncan[8] and the extensive clinical trial of Webster et al.[9] focused attention on the use of dry cold in immersion foot and allied conditions.

In four of our cases with bilateral gangrene, dry cold was applied to one foot by means of ice bags changed at very frequent intervals, while the other foot was left exposed to the temperature of the ward. The patients were given a regular hospital diet and sedation as needed to keep them moderately comfortable.

CASE 1. A private, aged 20, admitted 8 January 1944. Family history was good except for moderate hypertension in his mother; past history, excellent; smoked twenty cigarettes a day for thirteen years. Feet wet and exceptionally cold 28 December 1943 to 7 January 1944, in freezing weather. On 31 December 1943 removed shoes because of numbness and pain in both feet, at which time all toes were almost black and most of the foot dead white. Marched for seven hours en route to rest area just prior to hospitalization. Examination showed swelling of both feet with exquisite tenderness and a line of demarcation on the right foot about midway on the longitudinal arch; below this line the skin is black, insensitive, and cold; above the line are intense redness, brawny induration, tenderness, and markedly increased heat of the skin. This reaction extends over all the lower one-third of the leg. On the left the line of demarcation runs from the base of the 2d toe about the base of the first toe. Distal to this line is the same black, insensitive, cold skin, proximal to it the same marked inflammatory reaction which extends to about the level of the maleoli. Moderate inguinal adenitis.

Treatment. The right foot was bathed in alcohol, wrapped in a thin sterile towel, surrounded by five carefully dried ice bags which in turn were surrounded by a large bath towel, and the whole enclosed with oiled silk. Ice bags were changed about every hour and one-half.

Course. Completely afebrile. Throughout the first eight days the patient had moderately severe, aching pain in the left foot, none in the right. By the end of the second day the line of demarcation on the left foot had become firmly established; shrinkage of the toes distal to the line then became progressively more marked. The swelling in the two feet subsided about the same time and was all cleared in fourteen days. The line of

8. Brooks, B., and Duncan, G. W.: (1) Effects of Temperature on Survival of Anemic Tissue; Experimental Study, Ann. Surg., 112:130-137, July 1940; (2) Influence of Temperature on Wounds, Ann. Surg., 114:1069-1075, Dec. 1941.

9. Webster, D. R., Woolhouse, F. M., and Johnston, J. L.: Immersion Foot, J. Bone Surg., 24:785-794, Oct. 1942.

demarcation remained indefinite on the right, could be noted to recede distally for about eight days, when it became fixed just at the base of the skin of the toes. Gradual separation at both lines of demarcation set in at about the tenth day, revealing healthy granulation tissue just under the deepest layers of the skin. Throughout the period it was impossible to cool the foot by this method so that the skin felt very cold to the examiner's hand, although it was maintained at a temperature a number of degrees below that of the left foot.

CASE 2. A private, aged 19, was admitted on 8 January 1944. Family history good. Past history excellent. Feet wet and exceptionally cold 28 December 1943 to 6 January 1944 in freezing weather. Did not remove shoes in this period. On 4 January 1944 noted numbness and pain in both feet. Very little walking at end of period of exposure. Examination showed both feet swollen. Line of demarcation on both feet at about level of transverse arch; below this line the skin was black, insensitive, and cold, and above the line intensely red, brawny, tender, and hot. Pulsation in dorsalis pedis bilaterally good. Marked tenderness and pain in both feet. All toes apparently gangrenous. Both feet bathed in alcohol, the right wrapped in a thin sterile towel surrounded by five ice bags which were changed every hour. Pain in left foot so intense patient required morphine every four hours and still was very uncomfortable. Swelling in the left foot increased for the next five days; at end of two days line of demarcation on the left had become very clear-cut just distal to base of all toes with some increasing loss of substance distal to the line. On the right, line of demarcation remained indefinite for eight days, gradually receding distally for nine days as swelling in right foot decreased. Ice discontinued at end of nine days because of cessation of all inflammatory reaction. At no time was it possible by this method to get right foot so cold that it felt very cool to the examiner, although its temperature was maintained a number of degrees below that of the untreated foot.

CASE 3. A private, aged 29, was admitted on 8 January 1944. Family history good. Past history excellent. Feet wet and exceptionally cold 25 December 1943 to 5 January 1944 in freezing weather. Very little walking at end of period of exposure. Onset of numbness and moderate pain 3 January 1944, but shoes not removed at that time. Examination showed swelling of both feet, extending to knee on left, to lower one-third of calf on right. On left foot, line of demarcation about bisects the longitudinal arch; below line the skin is black, insensitive, and cold; just proximal to line is a very large bleb containing clear fluid, another such bleb on heel; the rest of skin of foot and lower leg is intensely red, brawny, hot, and tender. On the right the line of demarcation is about at level of transverse arch; several clear blebs proximal to this line where the skin is red, hot, tender, brawny, distal to line the skin of 1st, 2d, 3d and distal phalanx of the 4th toes is black, insensitive, cold. Both feet bathed in alcohol, the left foot wrapped in thin sterile towel surrounded by five ice bags, changed every forty-five to sixty minutes because of rapid melting of ice. At that it was impossible to keep left foot cold enough for the skin to feel cool to examining finger, although its temperature was kept many degrees below that of the untreated foot. Swelling in left foot increased slightly for four days, then gradually subsided. Swelling in right foot increased for six days, then decreased. There was more pain in right foot than the left. On the right, line of demarcation had become stationary distal to original location at end of fourth day; on the left, line remained indefinite for sixteen days, then became definite just distal to transverse arch. Because of degree of involvement patient was on sulfathiazole. On 23 January temperature rose to 102°. Temperature became normal soon after drug was discontinued.

CASE 4. A private, aged 21, was admitted on 8 January 1944. Family history good. Past history excellent. Feet wet and exceptionally cold 1 January to 4 January 1944 in freezing weather. Onset 2 January of numbness and pain; shoes not removed at the time. Very little walking at end of period of exposure. Examination showed both feet swollen. On the right, a line of demarcation at base of the 1st toe extending around base of terminal phalanx of 2d toe. Distal to this line, skin is black, insensitive, cold; proximal to line, swelling, redness, tenderness, increased local heat, and induration of the skin with three clear bullae. On the left is line of demarcation at level of transverse arch; distal to line the skin is black, insensitive, cold; proximal to line, the skin is red, hot, tender, with five large clear bullae. Swelling on right extends to level of maleoli. Both feet were bathed in alcohol; the left then wrapped in thin sterile towel surrounded by five ice bags which were changed every two hours; impossible to keep treated foot so cold that the skin ever felt really cool to examining hand, although it was kept many degrees cooler than the untreated foot. Swelling on left foot remained stationary for four days, then gradually receded. Line of demarcation on left remained indefinite, gradually receding for ten days, then became stablized at base of terminal phalanx of 1st and 2nd toes. On the right, line of demarcation remained stabilized from time of admission; within two days there was beginning shrinkage of tissue distal to the line. Swelling in right foot continued to increase for three days, then gradually subsided. Throughout there was slightly more pain in the untreated foot. Ice was withdrawn 22 January because of absence of inflammatory reaction.

We applied this form of dry-cold to one side in four milder cases with bilateral swelling but without gangrene, to the involved foot in two cases with unilateral gangrene of all toes and to both feet in one case with presumptive gangrene of all toes of both feet.

These cases are insufficient as a basis for sweeping conclusions because (1) the number is too small, (2) in the gangrenous cases there was a difference in the extent of the process in the two feet and we treated the worst foot, and (3) they arrived at this hospital from one to five days after the end of their period of exposure. It was obvious, however, that the cooling had a marked analgesic effect and it did no appreciable harm, even in badly damaged feet. In our cases this method of cooling was very inefficient.

FITNESS FOR DUTY

While most authors dwell on the chronicity of this condition and speak of prolonged sensitivity to cold, we found only one reference to the disposition of such cases from a military standpoint. Ungley[10] described a follow-up on 18 of 80 cases which revealed that 2 had been invalided, 7 were doing full duty, and 9 were doing limited duty.

10. Ungley, C. C., and Blackwood, W.: Peripheral Vasoneuropathy After Chilling; "Immersion Foot and Immersion Hand," with Note on Morbid Anatomy. Lancet, Lond., 2:447-451, 17 Oct. 1942.

We had 38 patients whose symptoms were very mild but whose history revealed that their symptoms had recurred so promptly and so often when their feet became even mildly cold that they were unable to do combat duty. In a very large number of our cases, the response of the skin to slight changes in the temperature was striking. When the feet were first removed from under the covers, the skin was of about the same temperature as that of the lower leg; but when the feet had been exposed to the cool air of the ward for five minutes, the skin of the feet was much colder than the skin of the leg.

Davis et al.,[11] using thermocouples and cold chambers, demonstrated the striking difference between the rate of cooling of the skin of a hand previously damaged by cold and that of a normal hand. However, our study suggests that past history of symptoms from exposure is not an important predisposing factor in the production of trench foot. About 60 percent of our cases were so mild that they were ambulatory on the fourth day of hospitalization.

An effort has been made to evaluate these patients from the standpoint of fitness for full duty. Eighty mild cases were subjected to five-mile hikes daily, conducted by an officer patient convalescing from this condition; cold pressor tests were applied in the usual manner and by submerging one foot in the ice bath and recording of the pulse and blood pressure variations and the time of appearance of pain. Those patients who had no subjective or objective changes from at least three hikes and no abnormal response to the cold pressor test were returned to full duty. In this manner 62 patients were returned to full duty after an average hospitalization of twenty-one days. It has not been possible to check up on all these patients; however, two of them have been readmitted here.

An officer with three years' service was admitted on 12 December 1943. His feet had been wet and cold for ten days in nonfreezing weather. He had moderate swelling of both feet with numbness, itching, and burning on exercise and when feet were warm. Because of the tactical situation, he was unable to report for hospitalization for one week. During this week the swelling slowly subsided while the itching, burning, and pain increased. He had no previous history of symptoms from exposure. Examination at time of admission here showed no swelling or discoloration of the feet. The feet were cool and dry with moderate tenderness to deep pressure over the balls of both feet. The tenderness disappeared within four days on simple rest. He conducted six of the five-mile hikes without objective or subjective changes. Cold pressor test was normal. He was returned to full duty on 29 December 1943 and was readmitted to this hospital on 8 January 1944. He had stayed in the replacement center five days then rejoined his organization; on the following day he marched about eight miles and moved into a defensive hill position. His feet became wet and cold and he promptly

11. Davis, L., Scarf, J. E., Rogers, N., Dickinson. M.: High Altitude Frostbite, Surg. Gyn. Obst., 77:561-575, Dec. 1943.

developed deep-seated, aching pain. Through that night the tactical situation permitted some sleeping in the foxholes, but the pain in both feet prevented this. On the following morning he was sent back for hospitalization by his battalion surgeon. At the time of admission here there was no objective evidence of disease and the pain had subsided.

A sergeant with nearly three years' service was admitted on 5 December 1943. His feet were wet and cold for seven days in nonfreezing weather. There developed mild swelling, burning, and aching of both feet. The swelling lasted two days. On admission here there was no swelling, both feet were cool and slightly tender. In eight days of simple rest all symptoms subsided. He went on three of the hikes without objective or subjective changes in the feet. Cold pressor test was normal. He was returned to full duty on 16 December 1943, but was readmitted on 4 January 1944. After ten days at the personnel center he had rejoined his organization. Five days later he went on a five-mile forced march during which his feet were wet and cold. His feet became slightly swollen, painful, and tender so that he was unable to walk. On admission there were mild tenderness and mild pain, but no swelling. All symptoms cleared within forty-eight hours on simple rest. He was then reclassified to limited duty.

DISCUSSION

Although it seems to be clearly recognized in the literature (The Bulletin has stressed the importance of slow thawing and the application of actual cooling during the period of thawing), only 34 of our patients gave a history of any specific effort being made at previous medical installations to bring this about. This omission of early treatment is extremely important, for after several days have elapsed the golden opportunity has been lost, and there is little reason to think that any therapy later will be particularly helpful. This condition should be considered as a medical emergency. Therapy should be applied by the first medical officer who sees the patient and his evacuation should be considered only after early treatment has been fully exploited or evacuation can be accomplished without interruption of therapy.

Suggestions for early treatment:

1. Remove all potentially constricting clothing and shoes.

2. Prohibition of walking or weight bearing on the feet.

3. Immediate application of cooling by the most efficient method at hand, and the continuation of such cooling until its slow withdrawal does not result in the feet becoming noticeably warmer than the rest of the body.

4. Strict avoidance of all warming agents (clothing, dressing hot water bottles, stoves, etc.).

5. Strict prohibition of all massage.

6. Avoidance of sympathetic block at this early stage.

A Division Dental Clinic in the Field

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Dental treatment for units undergoing field training away from a permanent camp usually is done at the unit dispensary. The following procedure took place with an infantry division, but with minor changes the same operations could be used by many types of organizations under various climatic conditions.

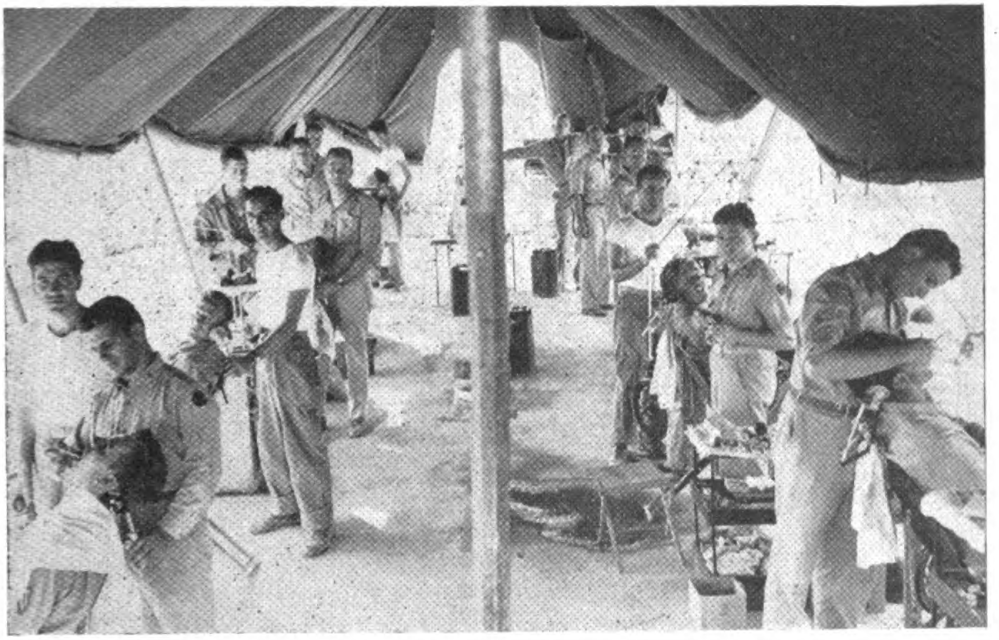
The division dental clinic was established in a ward tent in the medical battalion area which was centrally located. Fortunately the floor was of concrete. The tent was raised 2 feet by lengthening the poles, and by rolling up the sides of the tent more light and air were provided. These items were essential as artificial light was not available and the temperature was uncomfortably warm. The personnel included all the dental officers and dental technicians of the division, with the division dental surgeon in a supervisory capacity. All dental personnel were rationed and quartered with the medical battalion, and they were free of extraneous duties that usually arise in their own units to hinder their rendering dental service.

The equipment was the regular field-type M.D. Chest No. 60 supplemented by a gasoline camping stove, an 8-in. by 14-in. instrument sterilizer, and laboratory M.D. Chests Nos. 61 and 62. This sterilization equipment was of convenient size, and also it diminished the problem of fuel. M.D. Chests Nos. 61 and 62, which were not part of the Tables of Equipment, were lent to the division as an aid in the construction of dentures. The folding canvas or rubber basins of the field chests were used as wash pans. The box-type cuspidor stands were constructed of scrap lumber and No. 10 tin cans were used as receptacles. Supplemental tables, wash stands, a supply closet, laboratory work bench, and a bulletin board were constructed of scrap lumber. Laundry service for the towels was furnished on a weekly basis by a nearby quartermaster laundry. Requisitions for dental supplies were made weekly for the entire clinic direct to the division medical supply. A rolling stock of supplies was built up for immediate issue.

The usual dental survey was accomplished and the patients were called in as is usually done in other dental installations. In the unit dispensaries an enlisted man was detailed to take the request for dental patients direct to the orderly tent of the company concerned, and very few misunderstand-

ings or broken appointments were experienced. The patients were transported from the unit dispensaries to the clinic by ambulances of the medical battalion at the beginning of each working period of the day. A separate tent for waiting patients was provided. The patients were delivered back to their units as an ambulance load accumulated.

In the early part of each morning one or two officers held dental sick call and one treated the cases of Vincent's stomatitis, and one officer spent full time doing prostheses. Usually one officer did the more extensive type of surgery.



Dental clinic in the field.

Otherwise each officer called patients from his own unit according to the urgency of their classification. He did surgery as well as operative dentistry. He determined the patients he needed, made his own appointments and reappointments, kept his own daily work sheet, and made and kept in file his M.D. forms 79. The only exception to this was in the units of more than one dental officer, in which case the appointments and records were made and kept for the unit. There was the understanding that if all the patients from one unit were taken care of before the working period was over, the dental officer or officers of that unit were expected to help care for patients of another unit. The privilege of working for men of one's own unit resulted in more dental services being rendered.

The mimeographed form issued to each unit dental surgeon was much like M.D. Form No. 57 (revised 10 November 1930) except that it was enlarged to allow a daily entry, including change in classification. These were kept current

and quickly revealed the dental status of the unit and from these the various reports were made. Weekly and monthly reports were made to the division dental surgeon, who in turn compiled them for reports to the division surgeon and higher headquarters. Dental cases requiring x-rays were sent to a nearby hospital. If the officer requesting the x-rays desired to view them, he could do so by requesting their return. Otherwise the findings were reported on a consultation form. Cases needing several days of hospitalization were sent back to the hospital while cases needing a briefer period were kept in the clearing station of the medical battalion.

Impressions for dentures were made by using the equipment and materials of the M.D. Chests Nos. 61 and 62. The results of these impressions and pertinent data were sent to a central dental laboratory and base general depot where dentures were constructed. Only the full dentures were returned for "try-in." Later, permission was obtained to process the dentures in the clinic. The volume of prosthetic work to be done could not be produced by the limited equipment and materials contained in the chests but it was more expedient in the individual case.

There are obstacles to overcome in field work in desert areas. The hot, arid atmosphere makes the placing of silicate fillings very difficult, if not impossible, unless special treatment is given. This can be overcome by leaving the glass slab and silicate instruments in a thermal jug of ice water for a few minutes prior to using; if ice is not procurable, the same results may be obtained by wrapping these articles in a wet towel and leaving the bundle exposed to the air for several minutes. If the slab was left slightly moist, it did not seem to interfere with the setting or later hardness of the silicate fillings.

All equipment was placed in the chest at night, except the chair and base of the foot engine. Storm and strong winds and dust were detrimental to anything subject to breakage or dirt.

Palatable drinking water for the personnel of the clinic and patients was supplied through the use of water bags and paper cups. The use of common drinking cups and common water bags was discouraged as the spread of Vincent's stomatitis by these proved imminent.

Vincent's stomatitis was prevalent in this division and all measures were exercised to prevent its spread. Most cases responded favorably to treatment with chromic acid (7 percent topically) and hydrogen peroxide (half-strength as mouth wash) and better oral hygiene.

There are advantages and disadvantages in the operation of a dental clinic in a field for a division. The time lost from one's unit during a visit to the dentist is longer than if the officer were on duty in the unit dispensary. This is true whether

it be a minor condition on which the patient is seeking the opinion of the dental officer or something that will require a few sittings to correct. It is considered impractical by some to deny dental officers and technicians the military experience gained by participating in hikes and problems with their unit. This, however, is minimized by the fact that in the clinic they can devote full time to their primary mission, that of making ready the military personnel for combat duty.

The following advantages, however, far outweigh those disadvantages. A compact installation is more easily and effectively supervised. Being free of other duties the personnel accomplished more dentistry. There was an economy of time and effort even in the limited extent to which this clinic was departmentalized. Procurement and distribution of supplies were more uniform, and there was always the unusual case that the personnel of the clinic could profitably observe.

Treatment of Undisplaced Fractures at the Ankle Joint

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MAJOR LEON J. WILLIEN
Medical Corps, Army of the United States
and
MAJOR PATRICK C. DORAN
Medical Corps, Army of the United States

A soldier with a sprained ankle cannot be told to go home and rest. His "home" may be a barracks or a bedding roll. His injuries—strain, sprain, or fractures—need hospitalization. This means loss of fighting power. Treatments even though unorthodox that speed his return to duty are commendable.

In civilian practice in industry, the treatment may be altered to suit the efficiency record of a department; one-handed jobs, sitting assignments, and elevator jobs are given to an injured employee to keep him at work and to prevent time-loss from appearing on the departmental record. No such refuge exists for the injured soldier. There is no such thing as part-time activity in an Army organization. Many injuries, therefore, receive hospital care that in civilian practice would be treated as office or outpatient cases. These conditions have advantages. The patient is under complete control. He will stay in bed and he will attempt to move his foot and ankle when ordered. The combination of military living conditions and the judicious use

of restraint on the soldier-patient's activities have led to a change in treatment of certain types of fractures at this post.

Many in civilian practice had observed that undisplaced or slightly displaced fractures not requiring manipulation recovered full function of the affected part more promptly if protection and no immobilization were used. Sites that are outstanding as examples of this principle of treatment are the head of the radius, the lumbar transverse processes, the tarsal or carpal phalangeal "cracks," metacarpals and metatarsals. The treatment plan of nonimmobilization for march-type fractures had been carried out most successfully at this post with a considerable saving in the duty-lost period.

By instinct and training, however, most of the officers assigned to the orthopedic section have considered the ankle joint bony structures an area that demands rigid immobilization when a fracture violates its integrity, whether displacement accompanied the break or not. The set rule was that such injury called for fixation by plaster of paris dressing.

It was noted that the bony injury which most frequently occurred about the ankle joint involved the distal one-fourth of the fibula, at the external malleolus or slightly above it in the fibular shaft; also that the convalescent—out-of-plaster—phase was frequently longer than the time of immobilization. This period was characterized by persistent dependent swelling, pain on weight bearing with crutches, and limitation of motion. Many of these patients had the partial use of their extremity throughout the immobilized period by attached or incorporated walking devices. For this type of injury a revision of treatment was instituted. Immobilization was discarded in favor of bed rest, elevation, ice packs, and early active mobility. Weight bearing with crutches was permitted upon subsidence of the soft-tissue damage. It is to be emphasized that all such treated cases needed no manipulation. The security of the ankle joint mortise was proved by thorough accurate x-ray studies in the anteroposterior, lateral, and oblique views. Treatment of the bony lesion was subordinated to that of the soft-tissue damage. Early non-weight bearing motion was encouraged preceding weight bearing, and early supplemental aid by hydrotherapy, massage, and gentle manipulation was instituted. Weight bearing was permitted when the patient exhibited complete recession of soft-tissue damage, objectively and subjectively.

The impression of the officers of the orthopedic section was that this group of nonimmobilized cases recovered more rapidly than did the immobilized ones. These impressions led to a survey of immobilized and nonimmobilized cases. The records of 32 external malleolar fractures without any or with minimal displacement which were treated by a circular plaster of paris dressing were contrasted with a similar number which received the bed rest and nonimmobilization routine. There was no selection of cases. The registry was scanned for 32 consecutive cases where treatment included circular plaster immobilization and 32 without it where pattern of injury, by x-ray and clinical evidence, was comparable.

The comparison was based solely on number of hospital days necessary for complete rehabilitation. All patients in their convalescent phase had the same treatment; namely, physical therapy first and, secondarily, physical therapy plus convalescent drill. It was felt that the drill was the more effective for soft-part rehabilitation and furnished the test of fitness for duty. Drill for convalescents was utilized at this post long before it became the established treatment by directive. All patients were reviewed prior to discharge from the hospital at the daily conference.

TIME SAVED BY NONIMMOBILIZATION

The average period of hospitalization and duty days lost by the immobilized cases was 57.3 days. For the nonimmobilized cases the duration of hospital stay was 35.7 days. The difference, about three weeks, is a saving of time during the important training period. In a few of both series there were days added for which the fracture treatment could not be held accountable. Upper respiratory infections, venereal disease, and miscellaneous consultations occasionally delayed discharge and return to duty. Since these occurrences were distributed equally in this series and but a few cases were affected, it did not materially alter the average figures. The reclassification board was consulted and its files revealed no record of reclassification to limited service for any of these cases.

This section feels that the nonimmobilization treatment for this type of fracture is to be recommended because control can be exercised over the patient. The chief reason for recommending this treatment is the saving in hospital days and consequent earlier restoration to training or duty for the soldier.

Classification of the Shigellas

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Numerous attempts have been made to classify the organisms cultured from cases of bacillary dysentery, and those having similar properties but not considered pathogenic. The finer degrees of differentiation between members of this group may have little significance; nevertheless, in making a prognosis and in the use of therapeutic serum, a differentiation between *Shigella dysenteriae* and the remainder of the genus *Shigella* may be valuable. The epidemiologist, in his studies of the prevalence of carriers, modes of dissemination, and sources of infection should know exactly the species of organisms encountered in a given situation. Furthermore, attempts at prevention through active immunization depend on a thorough knowledge of the structure and relationships of the bacteria which may cause dysentery. Likewise, the bacteriologist, in his research on the nature and peculiarities of bacteria, needs an adequate system of classification for any group of organisms.

The first bacterium to be identified as a cause of bacillary dysentery was isolated by Shiga[1] in 1898. It was a nonmotile, gram-negative rod which produced no acid in lactose media and no gas in any carbohydrates. This bacterium formed a potent exotoxin and is the only organism thus far isolated from dysentery patients to do so. It has been known by such names as *Bacillus dysenteriae, Baccillus shigae, Bacterium shigae,* is now called *Shigella dysenteriae* in American and *Bacterium shigae* in English literature, and may be considered as the type species of the genus *Shigella.* The generic term *Shigella* has led to some confusion since many physicians fail to distinguish between the genus term *Shigella* and the older species term *Shiga.*

In 1900, Flexner[2] recovered from dysentery patients an organism similar to Shiga's but differing in that it produced acid in mannitol and did not form a potent exotoxin. In the same year

1. Shiga, K.: Cent. f. Bakt., I Abt., 23:599, 1898.
2. Flexner, S.: Phil. Med. J., 6:414, 1900.

Strong,[3] and in 1905, Hiss and Russell,[4] described organisms similar to Flexner's but differing in minor characteristics. These organisms, all of which ferment mannitol, and others since discovered have been grouped as types of the species *paradysenteriae.*

Duval,[5] in 1904, described an organism which resembled paradysenteries in most respects but produced acid from lactose after several days of incubation. Kruse[6] described an identical organism in 1907. Sonne[7] included this organism in his attempt at classification and it came to be associated with his name; while it is now known as *Shigella sonnei,* it has also been called the Sonne-Duval, Sonne-Duval-Kruse, and Duval's bacillus.

The isolation by Clayton and Warren,[8] in 1929, of an organism unquestionably associated with dysentery but producing acid and a small amount of gas in glucose and dulcitol has complicated the problem of classification of Shigellas since failure to produce gas is one of the characteristics of dysentery organisms. This organism became known as the Newcastle bacillus and was placed with *Shigella dysenteriae* and *Shigella ambigua* because it did not ferment mannitol. Later a variant of this organism was found which, although serologically identical with the Newcastle bacillus, fermented mannitol. Boyd[9] subsequently isolated an organism serologically resembling the Newcastle bacillus but producing no gas and giving acid in mannitol. Thus, there appears to be no reason for placing these organisms in the Shiga-ambigua group. Serological studies, as yet unpublished, indicate that they are only remotely related to the paradysenteries. Hence, it would appear best to place them in a group by themselves until they have been further studied.

We may then divide the Shigellas into four groups; one, producing no acid in mannitol or lactose; two, producing acid in mannitol but none in lactose; three, producing acid in mannitol and slowly in lactose; and four, producing gas in some sugars.

Group I consists of *Shigella dysenteriae* and *Shigella ambigua,* an organism producing no demonstrable exotoxin and serologically distinct, having no cross with *S. dysenteriae.* It also produces indol, which *S. dysenteriae* does not. Group II is made up of the paradysenteries which are further divided into types on the basis of serological studies. *S. alkalescens,* although sero-

3. Strong, R. P.: J. A. M. A., 35:498, 1900.
4. Hiss, P. H., and Russell, F. F.: Med. News (N. Y.), 82:289, 1903.
5. Duval, C. W.: J. A. M. A., 43:381, 1904.
6. Kruse, W.: Deut. med. Wschr., 23:292, 338, 1907.
7. Sonne, C.: Cent. f. Bakt., I Abt., 75:408, 1915.
8. Clayton, F. H. A., and Warren, S. H.: J. Hyg., Lond., 28:355, 1929.
9. Boyd, J. S. K.: J. Hyg., Lond., 38:477, 1938.

logically distinct, is also placed in this group since it produces acid in mannitol and otherwise conforms. It is, however, of doubtful pathogenicity. Group III consists of the slow-lactose-fermenting organisms of which *S. sonnei* is the only pathogen of importance. *S. madampensis* is of doubtful pathogenicity, the others probably not associated with dysentery in man. Group IV consists of the Newcastle bacillus and related organisms. The following table presents this grouping in graphic form.

GENUS SHIGELLA

These are gram-negative, nonmotile rods which produce acid but no gas in a number of carbohydrates (exception, Newcastle-Manchester organisms).

Group I		
No acid in mannitol		
Indol not formed		*S. dysenteriae*
Indol formed		*S. ambigua*
Group II		
Acid in mannitol		*S. paradysenteriae*
No acid in lactose		*S. alkalescens* (Pathogenicity?)
Group III		
Acid in mannitol		
Acid in lactose (late)		*S. sonnei* (Indol —)
		S. madampensis (Indol +)
	Considered nonpathogenic	*S. ceylonensis*, *S. equirulis*, *S. gintottensis*
Group IV		
Acid in mannitol		
No gas		Boyd 88
Gas		Manchester bacillus
No acid in mannitol		
Acid and gas in glucose		Newcastle bacillus

Since many names have been given to these organisms, the following tables of synonyms may prove helpful:

Accepted terminology	Synonyms
S. dysenteriae	*Bacillus dysenteriae*, *Bacillus shigae* *Bacterium dysenteriae*, *Bacterium shigae*
S. ambigua	*Bacillus ambiguus*, *Bacterium schmitzii*, *Shigella schmitzii*

S. paradysenteriae	*Bacillus dysenteriae* (Flexner, Hiss and Russell, Strong) *Shigella flexneri*
S. madampensis	*Bacillus dispar*
S. sonnei	Duval's bacillus, Sonne-Duval, Sonne-Duval-Kruse

The paradysenteries comprise a group of mannitol fermenting organisms which cannot be adequately differentiated on the basis of biochemical studies. Serologically, however, a number of antigenically distinct races have been recognized. Andrewes and Inman[10] in 1919 studied the organisms of Flexner, Hiss and Russell, and Strong, and in addition a number of other mannitol fermenters and proposed a classification in which the Flexner organism was designated as V, the Hiss-Russell as Y, and the Strong as W. They added two new races, X and Z, and two subraces, VZ and WX. Other investigators have recognized that not all the paradysenteries were included in Andrewes' and Inman's list. Sartorius and Reploh[11] recognized eleven races. In a series of papers Boyd[9] reported in 1938 on studies of nearly 5,000 cultures of paradysentery and found a number of races which could not be included in the Andrewes and Inman series. Although not confirmed in all respects, Boyd's conclusions appear to be warranted and his suggested system of classification has been accepted by the British Army Medical Service.

Boyd claims that the Andrewes and Inman Y is not a valid type but represents a degraded W. This organism, he insists, has not been isolated from a dysentery patient in recent years, a statement which experience at the Army Medical School substantiates. He also claims that the Andrewes and Inman X strain is in reality a variant of Z. Thus Boyd leaves the V, W, and Z strains of Andrewes and Inman, which he calls Flexner I, II, and III, respectively. Flexner IV, V, and VI of Boyd's series include two strains isolated in India which share the group antigens of the Flexner series and the Newcastle-Manchester-Boyd 88 group which, although biochemically differing, are antigenically identical and also share the group antigens of the Flexner group.

In addition, Boyd found a number of other strains which, while fermenting mannitol, did not share the group antigens of the Flexner group. Of these, three which Boyd originally called 170, P288, and D1, he now calls Boyd I, II, and III, respectively.

10. Andrewes, F. W., and Inman, A. C.: Med. Research Com. Spec. Rep. Ser. No. 42, London, 1919.
11. Sartorius, F., and Reploh, H.: Zbl. Bakt., 126:10, 1932.

Three additional cultures which he called P274, D19, and P143, he did not include in his classification since D19 and P143 were of rare occurrence and P274 was related to alkalescens which he considers as not a dysentery organism. It may be suggested, however, that the question of the role of *S. alkalescens* in bacillary dysentery is still undetermined and that for purposes of classification, this organism belongs in the paradysentery group. A summary of these classifications follows:

Original name	Andrewes and Inman	Boyd's classification
Flexner	V	Flexner I
Hiss-Russell	Y	Not a valid race
Strong	W	Flexner II
—	X	A variant of Z
—	Z	Flexner III
Boyd 103	—	Flexner IV
Boyd 119	—	Flexner V
Newcastle, Manchester, Boyd 88	—	Flexner VI
Boyd 170	—	Boyd I
Boyd P288	—	Boyd II
Boyd D1	—	Boyd III
Boyd P274	—	Similar to alkalescens
Boyd D19	—	Rare occurrence
Boyd P143	—	Rare occurrence

SUMMARY

While further study may bring about minor changes in this classification, it is likely that they will concern additions to the paradysentery and lactose fermenting groups rather than fundamental regroupings. On the basis of present knowledge, there seems no other choice than to place the Newcastle, Manchester, and Boyd 88 organisms in a separate group.

LEGION OF MERIT

The War Department announced on 17 March the award of the Legion of Merit to Lieut. Colonel William J. Shaw, M.C., of Lafayette, Missouri. The citation follows: Exceptionally meritorious conduct in the performance of outstanding services in New Guinea from 1 March to 15 July 1943. Colonel Shaw was in charge of evacuation of all hospital patients of a combat division in the areas of Dobodura, Soputa, Morobe, and Nassau Bay. He rapidly established a system so efficient that there was never an interruption in the smooth flow of evacuations, and bed space was always available in hospitals. This result was accomplished with limited personnel and equipment by excellent planning and close supervision of all elements, including those in active combat areas. Colonel Shaw's ability and tireless energy enabled him to render service of conspicuous worth to his division.

Herniation of Muscles of the Lower Leg

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In an excellent review, McMaster[1] in 1943 found 17 cases of muscle hernia of the leg reported. He had seen 21 cases at the Marine Corps Base at San Diego. Although it has been stated that muscle herniae are rare, the writer has seen 31 patients with herniae of muscles of the lower leg, "sprinter's hernia," within a period of one year.

In several individuals the diagnosis of varicose veins had been made erroneously. It was not found necessary to aspirate the small tumor in any instance to disprove the diagnosis of varicosities. In each patient the diagnosis was made by elicitation of the following: A small tumor varying in size from ½ by ½ centimeter to 4 by 4 centimeters was present on the anterolateral aspect of the lower leg in its middle or lower third. The mass was soft, fixed, and would enlarge on voluntary motion of the ankle and toes. In all but 6 of the patients pain was experienced at the site of herniation after marching. The herniation produced no symptoms whatsoever in 6 patients. The tibialis anticus was involved in all but 4 cases. The peroneal muscles were herniated three times and extensor digitorum longus protruded in one. Herniation was

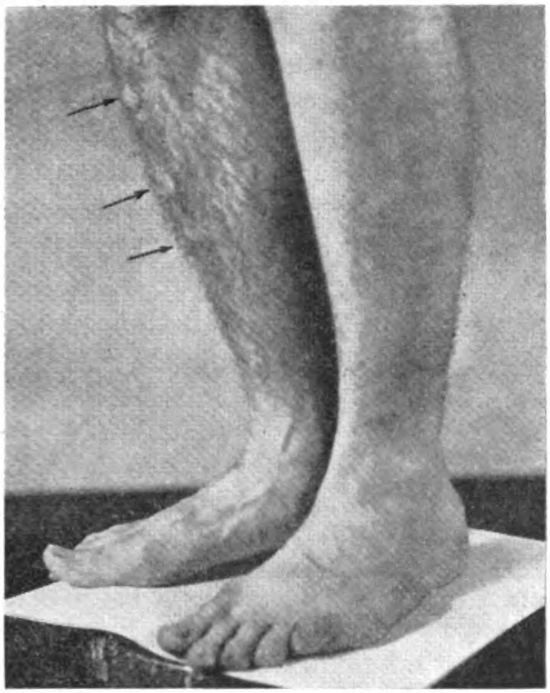

FIGURE 1. Multiple herniations of the tibialis anticus muscle. Minimal pain requiring elastic bandage only.

1. McMaster, Paul: Muscle Hernia of the Leg, United States Naval Medical Bulletin, 41:404-409, March 1943.

present bilaterally in 6 patients. The patients' ages varied from 18 to 40 years. Duration of pain was one week to four years.

Treatment in 14 patients who complained most bitterly of pain was operative. In the first case to be operated closure of the fascial defect at the site of the muscle hernia was attempted. The attempt was unsuccessful. Tension to such an extent was necessary to approximate the fascial edges that the wound broke down, the catgut suture material was partially discharged through the wound, and the hernia recurred.

In the remaining 13 patients a new procedure was performed. The hole in the fascia instead of being closed was simply enlarged so that the muscle would bulge through as a large mass instead of crowding through the original small opening. A cruciate incision of the fascia at the hernial site was therefore made. In every case operated, a defect of the crural fascia was present. The fascia at the edges of the defect was found to be thinned and dehiscent. The hernia disappeared in all cases operated on using the method described. In one patient, pain has persisted in the leg following obliteration of the hernia. Examination revealed that this soldier was psychoneurotic. He should not have been operated on.

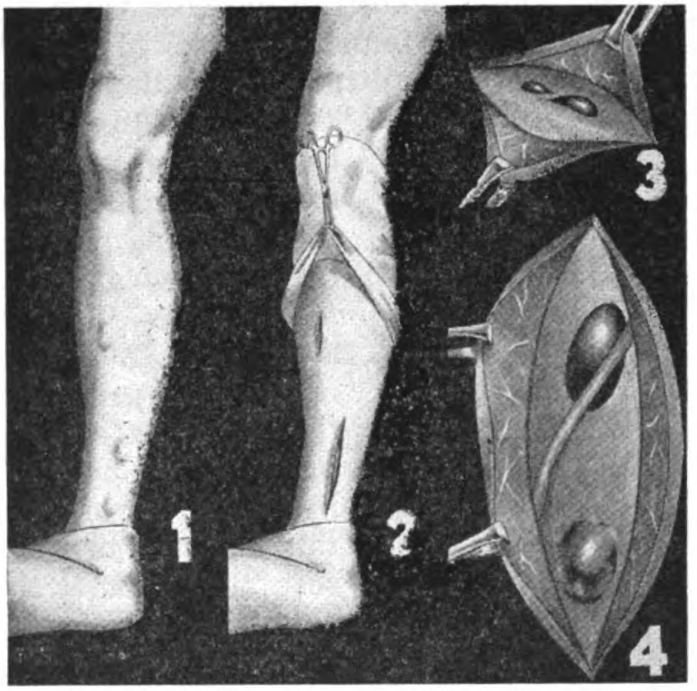

FIGURE 2. Drawings made in the operating room. Nos. 3 and 4 show the defects in the crural fascia.

The follow-up period has in no case been longer than four months. Fascia lata was not used to cover the defect as Hartzell[2] recommended. No definitive therapy other than the use of an elastic bandage was used on the 11 patients who complained of only mild pain at the site of the fascial defect.

2. Hartzell, John B.: Use of Living Fascia Transplant to Repair a Hernia of the Tibialis Anticus Muscle, J. A. M. A., 107:492, 15 August 1936.

Lessons Learned from Pension Rating Boards

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I have been on detached service for several weeks with the Veterans' Administration, with a rating board which passes on the requests of disabled veterans for pensions. Day after day we study the cases and recommend pensions or refuse them as the evidence justifies. We pass on hundreds of cases each week. Certain facts, I believe, will be of value to Army medical officers. In the first place, the majority of Certificates of Disability for Discharge (Form 40) which accompany the case histories of discharged veterans state, as to line of duty, "No - E.T.P.I." This opinion is based usually on the patient's statement that he has had flat feet since childhood or had asthma or epilepsy years prior to entering the service. Unfortunately the rating board cannot accept the opinion of the C.D.D. board in respect to line of duty. We are rating these cases under Public Law 144, 78th Congress, which specifically states:

> For the purposes of paragraph 1(a) hereof every person employed in the active military or naval service shall be taken to have been in sound condition when examined, accepted, and enrolled for service except as to defects, infirmities, or disorders noted at time of examination, acceptance, and enrollment, or where clear and unmistakable evidence demonstrates that the injury or disease existed prior to acceptance and enrollment and was not aggravated by such active military or naval service.

To prove that the disability existed prior to enrollment, the statement of the veteran is not acceptable and a statement of a reputable physician or other concrete evidence is required. For example, a discharged veteran states that he has had asthma since childhood. Unless we can obtain evidence from a physician who treated him for asthma or other concrete evidence of asthma prior to induction, the board is forced to allow service connection for the asthma and to award a pension. As a result, the majority of veterans discharged on a C.D.D. for asthma are being placed on the pension rolls.

The importance of the physical examination on induction increases tremendously under the application of this law. Yet I am forced to admit, as the result of studying hundreds of these cases, that the facts indicate that many of the physical examinations on induction might have been more thorough. Time and again we have men discharged on a C.D.D. for deafness or impaired vision shortly after entering on active duty. A study

of their physical examination on induction shows: "Hearing, right ear 20/20, left ear 20/20," or "Vision, right eye 20/20, left eye 20/20." In these cases it is quite evident that the defect existed at induction but was not noted by the medical examiner.

Item 11 in W.D., A.G.O. Form No. 22, Enlistment Record, is the following question: "Have you ever used cocaine, heroin, morphine, marihuana, or any habit-forming drug or narcotic; since childhood wet the bed while asleep; had gonorrhea, sore on penis; convulsions or fits, or spells of unconsciousness; raised or spat up blood; had any illness, disease, or injury that required treatment at a hospital or asylum?" Item 12 asks: "To the best of your knowledge and belief, are you now sound and well?" Most of the applicants answer Item 11 in the negative and Item 12 in the affirmative, many of them concealing knowledge of their previous ailments and infirmities. When questioned later they usually state, "I was afraid to admit that I had asthma, or wet the bed, because I knew they wouldn't take me into the Army if they found out." Yet, this same individual, after a month or two in training, when he finds that Army or Navy life is mostly hard knocks and discipline, begins to look for an easy way out and hits on his chronic ailment. It is inevitable that many chronic diseases like asthma, arthritis, and weak feet will be aggravated by full military service. These men then fill up our station hospitals and once in the hospital they confess they had the ailment "since childhood" or were in an "auto accident several years ago." They end up with a C.D.D. and a request for pension. Such individuals are a serious drawback to our military machine.

On the back of Form 221, "Report of Physical Examination and Induction," items 26(a) and (b) ask the examining physician, "Do you find that the above-named registrant has any of the defects set forth in part I of the List of Defects (Form 220)? Or part II of the List of Defects (Form 220)?" In many instances where the registrant admitted the presence of defects, the examining physician failed to develop the information properly. For example, an applicant stated that he had rheumatic fever four years previously and had a leaky heart. The examining physician answered item 26, "No defects found." The cardiovascular system was reported as "normal." Two months after induction this man wound up in a station hospital with acute rheumatic fever with mitral and aortic involvement. This case will probably cost the United States Government $30,000.00 in pension awards alone besides the expense of frequent hospitalization. This is figured on a basis of $50.00 monthly for the veteran (or his widow) for fifty years. Had this case been developed properly, the man would never have been taken into the armed services.

Another recent case deserves comment. On induction an individual when asked if he had ever been an inmate of an institution answered "No." Soon after induction his commanding officer noted that the man acted queerly and he was sent to the station hospital where a diagnosis of "dementia praecox, para-

noid type" was made. Investigation revealed that this man had been in an insane asylum where the same diagnosis had been made prior to induction, and whence he had been remanded to the custody of his wife and parents as an incompetent. Concealing his prior commitment, he was accepted into the Army and later discharged on a C.D.D., but his claim for pension was denied on the basis of evidence that he had been committed to an institution prior to induction for the same disease for which he claimed pension after discharge.

In considering our mistakes, the matter of reading x-ray films should be taken up. A veteran put in a claim for pension based on the findings of "pulmonary tuberculosis." We found that at the preinduction examination the x-ray of the chest was reported as "negative." The man was given ten days before reporting for active duty. During these ten days somebody noticed that his chest x-ray was positive for tuberculosis. On reporting for duty he was immediately hospitalized and eventually discharged on a C.D.D. for pulmonary tuberculosis. He filed claim for pension stating that the x-ray of his chest prior to induction was reported as negative. According to the law, this evidence had to be rebutted by "true and unmistakable evidence" to the contrary. The claim was denied and rebutted on the grounds of "sound medical principle that the tuberculosis could not have arisen in advanced form within the ten-day period between this man's examination and his reporting for active duty."

Another matter which gives us considerable concern is the diagnosis "psychoneurosis." Too often the veteran is given this tag when he apparently should have been a Section VIII man.

Whenever an operation has been performed in an Army installation, the proper recording of progress notes is very important from the standpoint of the rating board. This is particularly true after orthopedic or neurosurgical cases. The degree of recovery of function is particularly valuable in making estimates of disability. As rating boards study progress notes assiduously, it behooves our ward surgeons to keep these notes current. I have noticed a trend in histories to omit the discharge summary of the case. This should be corrected and no case history passed by the registrar until the discharge summary has been properly made. While these things bore ward surgeons, they are very important and their neglect seriously affects the equitable judging of pension claims.

CONCLUSIONS

1. The line of duty status is no longer acceptable as reported on Certificate of Disability for Discharge forms but is interpreted by the rating boards with respect to Law 144, 78th Congress.

2. When the examining physician has evidence that the inductee had a previous serious illness or injury, he should properly develop this evidence.

Apparatus

AIR-PRESSURE TOURNIQUET FOR THE THIGH

CAPTAIN DONALD H. HOOKER
Medical Corps, Army of the United States

Instances of prolonged disability following sciatic nerve injury secondary to application of a thigh tourniquet have recently been noted. A tourniquet which has proved safe has, therefore, been devised from available medical supplies. It is easily applied and a known pressure on the thigh can be attained and removed without delay. A disadvantage of this apparatus is that leaks will occur unless care is taken to avoid injury to the rubber from towel clips and pins, and unless the connections are airtight.

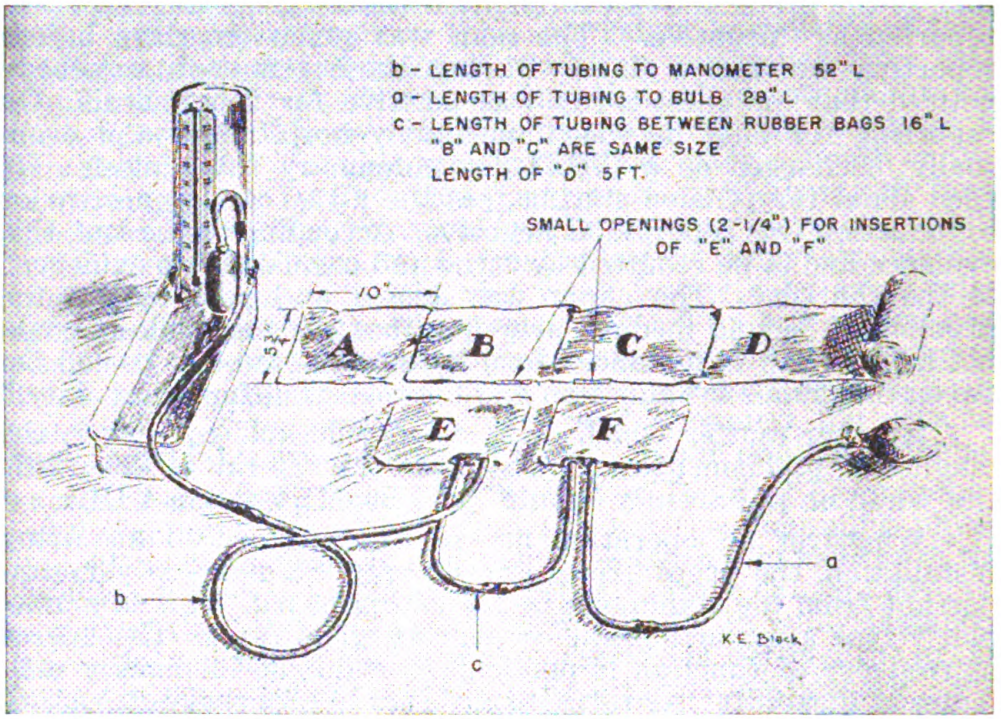


FIGURE 1

The materials needed to make this tourniquet are one standard sphygmomanometer complete with cuff and bulb, one additional rubber bag from a standard blood pressure cuff, several square yards of heavy cloth, preferably canvas, and 3 feet of moderately heavy rubber tubing with one nonbreakable connection.

The canvas is simply cut and sewed to make a large blood pressure cuff with room for two rubber bags. The cuff is made of a single long strip of canvas divided into four sections.

Division A in figure 1 represents a tab about 6 inches long which serves to fix the rubber bags and prevent them from slipping when inflated.

Captain Charles D. Sawyer and First Lieut. Ann Seney assisted in constructing this tourniquet.

B and C are compartments to contain the rubber bags which are hooked up in a series, one being attached to the manometer and the other to the hand bulb which accompanies the manometer. The rubber bags can be easily removed from their compartments through small openings where the tubing leaves the cuff. These openings can be kept closed with small safety pins or a piece of tape in the form of a shoe lace. It is inadvisable to use safety pins lest the bags be accidentally punctured. A tab 5 feet long (D in figure 1) is wrapped around the thigh over the rubber bags. Its end can either be tucked in or fixed by several extensions of tape wrapped in opposite directions and tied together.

The connections between the tubing must be strong and airtight and if possible made of a nonbreakable substance. The manometer should be disconnected when moving the patient, to prevent its being broken. If 3 feet of additional rubber tubing are available, an extension for the hand bulb can be made and will prove useful.

To obtain the best results, the foot is first elevated to empty the leg of blood before tightening the tourniquet. Then, as rapidly as possible, the rubber bags are inflated to about 25 millimeters of mercury above the systolic blood pressure. A small towel under the tourniquet will keep the canvas clean and protect the skin. One should check for leaks watching the manometer for several minutes before beginning any surgery. The pressure should not be maintained more than one hour continuously lest nerve injury result. A low pressure, permitting the arterial blood to pass beyond the tourniquet, is worse than no tourniquet at all because the veins and venules will become engorged and bleed profusely.

In our experience, this is one of the safest and most convenient types of tourniquets for operations on the lower extremities.

MOVING GRID FOR FIELD X-RAY UNIT

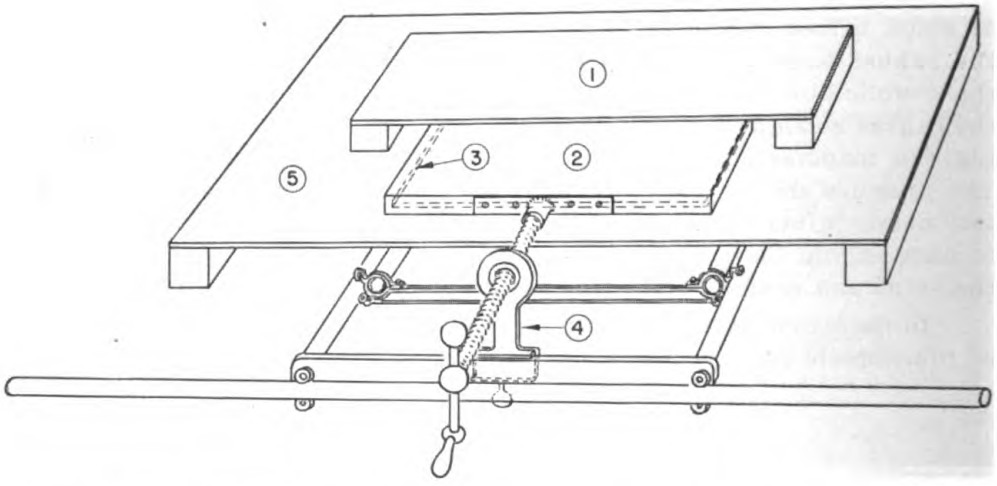
CAPTAIN LAMBERT F. MAMMOSER
Medical Corps, Army of the United States

An x-ray grid for improving visualization of thick anatomical parts has been constructed to supplement the roentgenographic equipment of an evacuation hospital. The Army portable grid unit of stationary type was not available, and films of thick parts, taken with the aid of cones and various adjustments of kilovoltage and milliamperage proved to be of no diagnostic value. The construction of the grid was an interesting accomplishment since, in this theater, materials other than those brought by the hospital were not available. Amazingly good results were obtained with the apparatus, the manufacture of which is a simple process.

The grid consists of a box, 20 by 20 by 1 inch thick, covered top and bottom with heavy cardboard. The box contains cardboard strips 1 inch wide, and in the center of each strip is pasted a strip of lead foil 1 cm. wide. When the cardboard and lead strips are placed in parallel position in the box, they number sixteen to the inch. The lead foil is obtained from the wrappings of x-ray films and the cardboard is cut from the cardboard x-ray film boxes.

Motion is imparted to the grid above the film cassette by a simple mechanism made by machinists of a nearby ordnance company. A screw is welded to a clamp which is fixed to the frame of the horizontal member of the x-ray table. Through the screw, a bolt is turned, pushing the grid before it. A few practice turns on the crank-type handle at the other end of the bolt will render the motion smooth and uniform.

The litter with the patient is placed on the ends of the field x-ray table. Beneath the litter, on boards constructed to span the rails of the table, is placed the film cassette, on which rests the grid. A piece of thin plywood, supported at both ends by stout boards, covers the cassette and grid to permit free motion of the mechanism and to support the pelvis or other parts to be radiographed. The grid ratio was computed by actual trial and found to be 2.5 to 1. Another grid composed of lead foil and cardboard, similarly made, gives about the same ratio.



1. Plywood cover which protects grid and cassette below from body part above. This cover is placed immediately beneath the litter.
2. Grid with film cassette (figure 3) beneath it.
4. Mechanism by which grid is moved, clamped on to horizontal member of x-ray field table unit. The bolt has six threads to the inch.
5. Flat top which rests on horizontal bars of x-ray field table unit.

Grid lines in the film are apparent but very inconspicuous. If the gear handle is turned to impart a smooth and uninterrupted motion to the grid, the lines are discerned in the film with difficulty. The uniformity of the motion of the grid and absence of jerking appear to be more important than the actual speed of the grid over the cassette. Slightly increased prominence of the lines does not detract from the diagnostic value of the film. "The technician who turns the worm gear is protected by placing a lead shield between him and the table. He wears a lead-impregnated glove and begins turning the crank before the other technician presses the button to take the exposure.

The only available references obtainable concerning the construction of grids were the War Department Technical Manual (TM 8-240) and *Manual of Roentgenological Technique*, by L. Sante.

CALIBRATED BONE-HOLDING CLAMP

CAPTAIN CAROLL M. SILVER
Medical Corps, Army of the United States
and
MAJOR HAROLD W. RUSBRIDGE
Medical Corps, Army of the United States

In the use of metallic plates for fixation of the bone fragments in fractures, one endeavors to use screws which will be long enough to transfix both cortices of the bone shaft and yet not penetrate into the neighboring soft tissues. The choice of the correct screw, in regard to length, is often haphazard, because measurement of the diameter of the involved area of the bone on the x-ray film is subject to the error of distortion inherent in routine x-ray study. This may be obviated in large measure by applying a ruler to the limb at the time of making the roentgenogram, but this involves an extra procedure in which the ruler must be placed accurately and in which the factor of distortion is not entirely eliminated. The withdrawal of a screw and reintroduction of a different-sized one during the

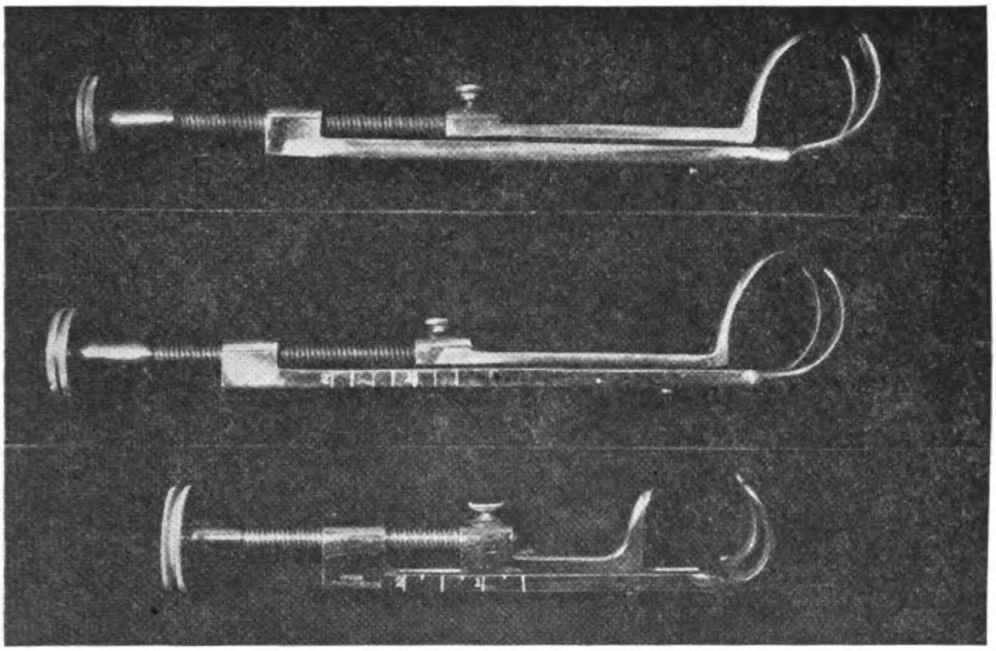


FIGURE 1. The lower two clamps have been calibrated in ¼-inch fractions. The uppermost clamp is not calibrated.

procedure weakens the holding power of the screw. The suggestion of a simple calibration* of the Lowman bone clamp, the standard issue in Army hospitals, was made by Cpl. Harold F. Weinberg of our operating room staff who carried out the technical details. He punched the numbers into the clamp with a metal-numbering set. The fractional marks were made with a file (figure 1). The calibrations may be made in either the metric or English system. To obtain the initial measurement, the bone clamp may be fastened around any firm cylindrical object such as a broom handle or section of metal pipe, the diameter of which can be measured with ease.

We have used the calibrated Lowman bone clamp with gratifying results. The proper-sized screw may be determined at a glance during

*Future specifications will require that bone-holding clamps be marked in this manner.

operation as soon as the bone clamp is tightened on the bone and superimposed metal plate. The readings obviously will be most accurate in a cylindrical segment of bone. Slight corrections may be necessary when plating a triangular area of bone, notably in the shaft of the tibia. However, even in that case, an accurate initial insertion of the proper-sized bone screw is usual.

IMPROVISED UNDERGROUND LABORATORY

CAPTAIN ALFRED E. A. HUDSON
Sanitary Corps, Army of the United States

While on duty with the First Medical Laboratory in Louisiana in 1942, permission was granted by the commanding officer, Lieut. Colonel Hugh A. McKinley, M.C., to construct an underground laboratory making use only of materials that were on the TBA and found as scrap. The objective was to demonstrate that, when tentage was scarce, a practical underground laboratory could be improvised, and that it would provide comfortable work room in very hot weather. The laboratory was 20 feet

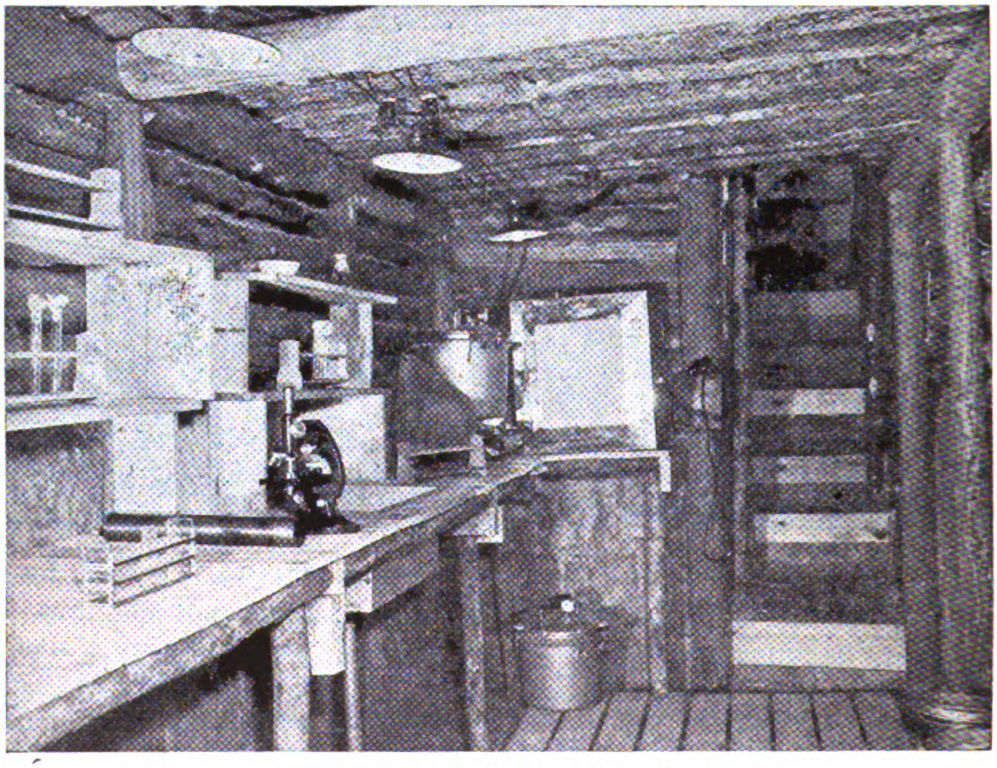


FIGURE 1. Interior of laboratory

long, 10 feet wide, and 9 feet deep. The main supports consisted of log uprights, 8 inches in diameter, interspaced with logs 6 inches in diameter extending from the roof to within 2 feet of the floor. The roofing was made up of logs 6 and 8 inches in diameter, reinforced with logs 5 inches in diameter. All log fastenings and connections were made with wooden pegs 1½ inches to 2 inches in diameter and 10 inches long. Soil was

packed on the roof and then covered with a tarpaulin on which more dirt was packed; then the original sod was replaced on the top of the dirt. The roof of the laboratory was in this way made level with the surrounding ground.

The entrance and exit were built on step fashion, reinforced with wood from packing cases. Electricity for lighting and operation of laboratory equipment was provided by Item No. 99600, Unit, power, electric, portable—110 volt, 60 cycle, A.C., which was placed 100 yards away, the lines to it being buried. While this generator was checked daily, it needed only minor adjustments every 80 to 100 hours. Ventilation was provided by means of vents made of tin from No. 10 and 2½-gallon cans soldered end to end, obtained from the mess. The sink was made of galvanized iron from two tent vents. Water was stored in 5-gallon milk and water cans. The entrances and exits were camouflaged with wood and logs giving the appearance of a typical woodpile.

Five persons worked in this laboratory for several weeks. With the exception of slight amounts of water coming through the entrances and exits during extremely heavy rains, the project was waterproof.

BIOCHEMICAL OXYGEN DEMAND TEST

CAPTAIN MAXIM LIEBER
Sanitary Corps, Army of the United States

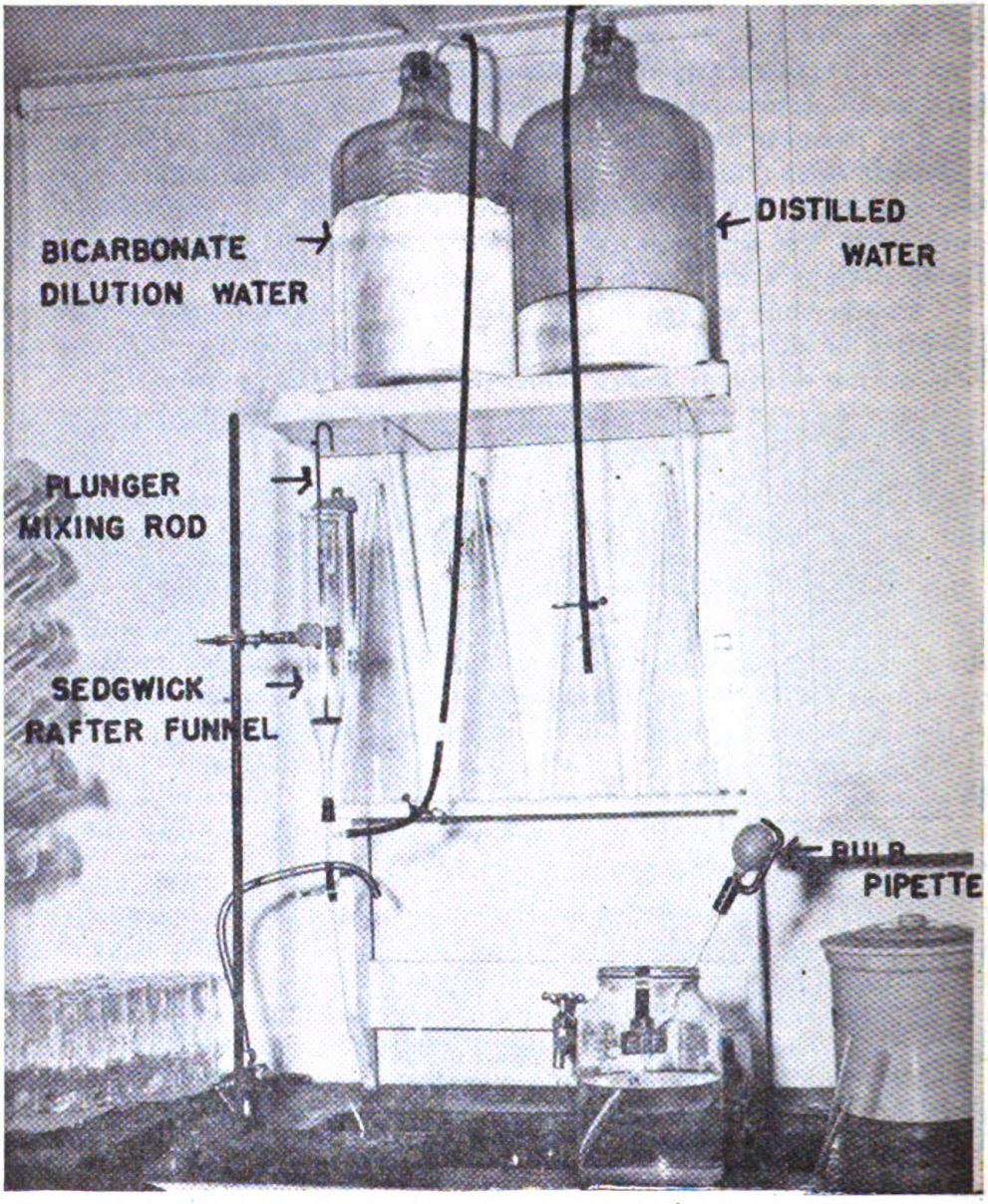
The biochemical oxygen demand test is important in the field of sewage treatment. When this test is done in the laboratory, it involves various setups for the preparation of dilutions of the sewage sample to be analyzed. To simplify the preparation of sewage dilutions for incubation at 20° C., a simple laboratory setup was devised at the Luke Field sewage treatment plant. This device enables one to prepare dilutions easily, with less chance of error, and to do a test without going through the usual elaborate preparations.

The figure illustrates the laboratory setup suggested. It consists of a one-liter Sedgwick rafter funnel with the one-hole rubber stopper connected to a "T" tube. The side arm of the "T" tube is connected to the siphon tube coming from the 16-liter bottle of sodium bicarbonate dilution water. The bottom end of the "T" tube has a piece of glass tubing which delivers the prepared diluted sewage sample to the BOD bottles. The flow in both arms of the "T" tube is controlled by two pinch clamps.

The bicarbonate dilution water is allowed to enter the Sedgwick rafter funnel until it is half full, by opening the pinch clamp of the bicarbonate dilution water siphonage tube. The proper volume of sewage for the desired dilution is transferred by means of the bulb pipette under the surface of the liquid in the Sedgwick rafter funnel. Additional bicarbonate dilution water is then permitted to enter the funnel up to the liter mark, and with the plunger mixing rod the sample is well mixed without entraining any air in the mixing process. The sample is then ready

for delivery to the BOD bottles by using the pinch clamp below the Sedgwick rafter funnel. Distilled water is conveniently located for the rinsing of glassware.

This procedure eliminates the customary method of using a one-liter graduated cylinder for the preparation of BOD sewage samples. The apparatus is compact with little chance of breakage. The siphon tubes



which are usually on hand for use with the graduate cylinder method are eliminated. A substantial supply of stabilized dilution water is available, thus keeping this setup in readiness to prepare BOD samples quickly and accurately.

This simple setup has been found convenient and time saving. It may be helpful to other laboratories doing sewage analyses.

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Carlisle Barracks, Pa., 5-2-44—75,000